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NEW INVENTIONS · MECHANICS · MONEY MAKING IDEAS
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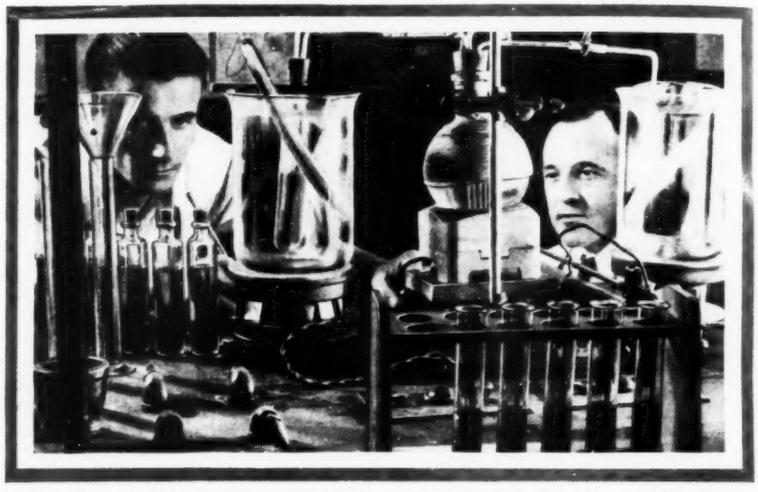
"Friction Fighters" Find New Way to Refine Oil

that will make Millions of Cars Start Easier this Winter

Why Mobiloil Arctic...made by the Socony-Vacuum Clearosol Process... makes starting easier—lasts longer ...keeps cars better protected against Winter



Scientists worked for months... putting the finishing touches on the Clearosol Process.

These huge tanks contain materials that wash out non-lubricating elements from oil.

MILLIONS OF CAREFUL motorists are getting their cars ready for hard Winter driving. Many have already changed to Winter oil. More will do so in the very near future.

Before *you* make any change—read the whole story of this remarkable new development in oil refining. Read every word... because it shows how you can save up to 25% on oil bills.

First get this point clear: all crude petroleum contains useless, tarry elements that have no lubricating value.

Now Socony-Vacuum has a new and revolutionary method of removing them.

Instead of relying on filter and acid baths, as is customary, the sensational new Socony-Vacuum Clearosol Process actually *dissolves out* the natural impurities found in even the best grades of crude oil.

What happens to the oil is amazing. It is practically 100% pure lubricant. When you put it in your engine, you discover:

FIRST—Mobiloil Arctic made by the Clearosol Process makes engine starting much easier in cold weather.

SECOND—Mobiloil Arctic made by this new process lasts as much as 25% longer.

THIRD—You have a cleaner engine—no gummed rings or stuck valves from this oil.

FOURTH—Mobiloil Arctic holds its body at high temperatures, staying on the job guarding your engine against wear, no matter how hot it gets.

With these many advantages, you might well expect the new Mobiloil Arctic to cost more. But it doesn't. The price has not been advanced one single red cent.

Now is the time to get your car in shape for hard Winter driving. Go to the nearest Mobiloil dealer—you'll know him by the Mobiloil sign with the red Gargoyle or the sign of the Flying Red Horse... and refill with clean Mobiloil Arctic. Act now.

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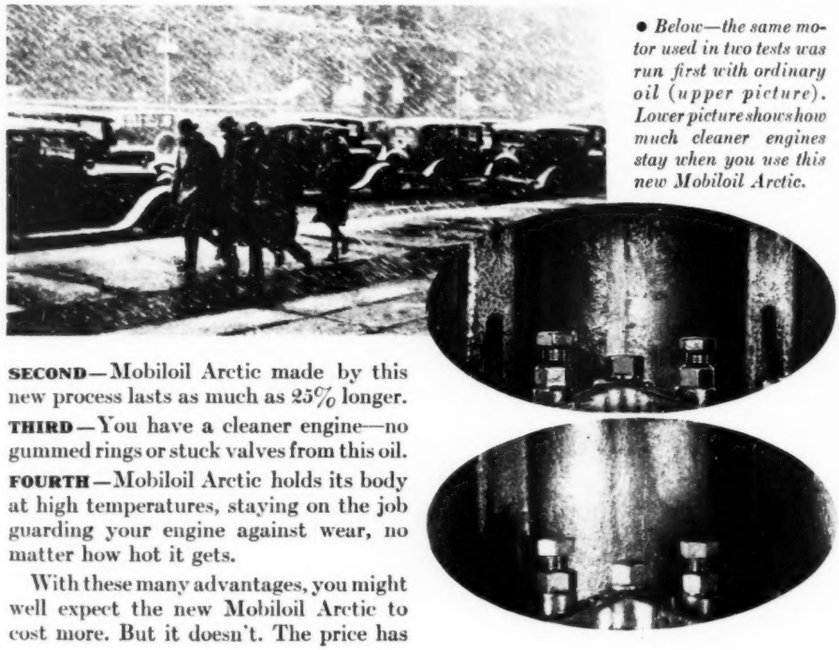

• *Below—the same motor used in two tests was run first with ordinary oil (upper picture). Lower picture shows how much cleaner engines stay when you use this new Mobiloil Arctic.*

Mobiloil Arctic

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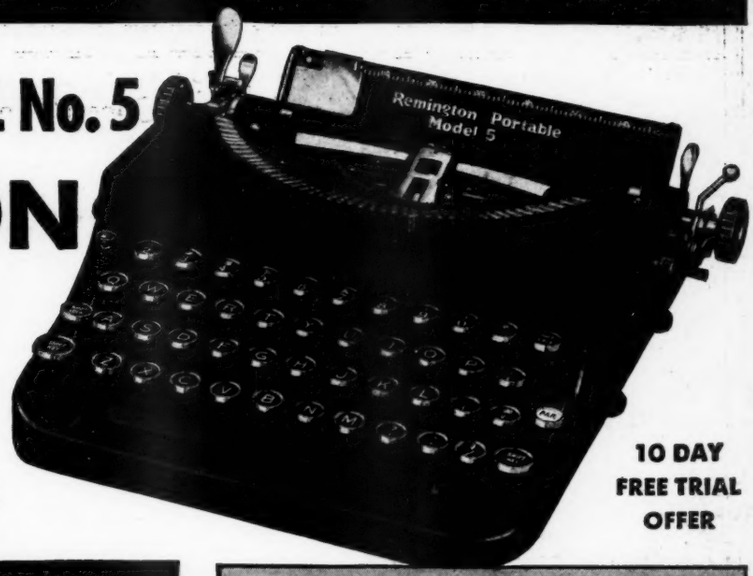

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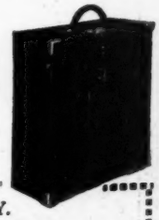

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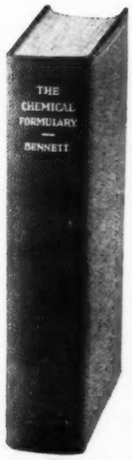

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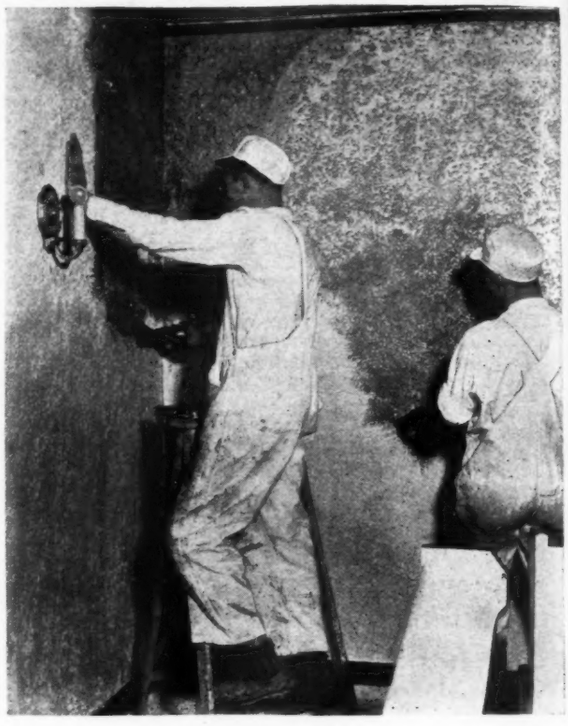
Right, brushing the glaze coat on a wall refinished with plastic paint. Note the rugged stippled texture that can be obtained by molding the paint into swirls with the fingers, a brush, or a tool made specially for the purpose



By
R. M. BOLEN
Secretary, Popular Science Institute

•

MODERN WAYS TO
Brighten Your Walls

MODERN materials and methods add new zest to the job of rejuvenating drab walls in the home. Wooden wall paper, paints that can be molded, and natural wood-fiber board are a few of the many wall surfacings now available to the home owner.

Even kalsomine, simple and inexpensive as it is, forms an attractive wall finish when it is applied the modern way. It is easy to apply and is just as easily removed, with a sponge and water, when its usefulness is at an end. This advantage, however, also is a disadvantage, since it precludes the possibility of cleaning the finished wall with water.

For mottled effects, three colors of kalsomine generally are used, separate patches being daubed on small areas of the well-sized wall and, while still wet, stippled and blended with a wad of newspaper crumpled into a ball. By confining the work to small areas at a time, the colors and blending can be graded and controlled.

To obtain a stippled effect with kalsomine, two colors are used. The first serves as a ground coat while the second provides the stipple. Once the ground coat has dried, the second color is stippled in place with a wad of newspaper or a sponge daubed in a brushful of the kalsomine spread on a board or piece of tin. The ground color may be light with a dark stippled overcolor, or dark with a stipple of a lighter tint.

Flexible wood wall covering, made of thin wood backed with canvas, is applied to plaster walls like regular wall paper

Where a longer-lasting wall surface is desired, quick-drying paint, another modern material, can be substituted to obtain the same stippled or mottled effects. Although more expensive than kalsomine, it has the advantage of washability.

Paint stippling is carried through in more or less the same manner as kalsomine stippling. A ground coat of flat wall paint is applied first and the stipple coat patted

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on with a sponge soaked in water to make it pliable and cut to produce an interesting texture.

For mottled paint finish, a slightly different procedure is followed. This type of decoration is produced by applying a foundation coat of flat wall paint and stippling or mottling over it with a coat of glaze colors. These glaze colors are transparent yet brilliant oil colors which allow the undercoat to show through to produce a rich depth of color.

GENERALLY more than one mottling color is used and in the choice of these colors lies the secret of successful glaze color finishing. In fact, unless one is an artist, it is advisable to follow the suggestions given in the flat wall-paint color folders issued by most manufacturers.

As with stippling, the first operation consists of applying a suitable ground coat. When this has dried, the glaze colors can be prepared by squeezing each oil color from its tube into separate containers of glazing liquid. Since the amount of color to be mixed with the glazing liquid will depend on the tone desired a little experimenting on the part of the novice will not be amiss.

When each glaze color is ready, the stippling can be started. The first step is to prime about a square yard of the undercoat with a thin coat of clear glazing liquid. The glaze colors, then should be brushed on generously, being applied simultaneously with separate brushes. One color, however, should predominate. Run the colors together as much as possible with a brush and then stipple them with a soft cloth held loosely in the hand.

Another variety of paint finish that has met with widespread popularity is the so-called plastic paint. Although available under a number of different trade names, this type of plastic finish invariably is sold as a prepared powder which, when mixed with water, forms a doughy plasterlike mass. It is applied with a brush and before it sets is stippled or molded into swirls or bumpy textures with the fingers, a spoon, a brush, or other similar tools made expressly for the purpose. Finally, when it has hardened, the molded finish is then partially smoothed and treated with a coat of glaze or glaze colors.

With the advent of fade-proof and washable materials, wall paper has become a truly modern finish. Withstanding the sun, as well as soap and water, it is available in an endless number of colors and designs for any room of any period. Even wall linoleums in plain, marbelized, and tile effects are now obtainable for use in the bathroom, the kitchen, or the pantry.

NEWEST of all wall coverings of the wall-paper type, is a flexible wood that can be "hung" with regular paper hanger's tools. Backed with canvas and sold in rolls like oilcloth or linoleum, it is as easy to work as a strip of wall paper and yet it is real wood with all the beauty of the natural grain of the tree.

Interesting paneled and wainscoted effects also can be obtained economically with attractive wood-fiber boards now on the market. This rigid type of wall covering is both inexpensive and easy to apply directly over old finish.

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Our Readers Say

The Rabbit Problem Solved Without Splitting Hares

THE problem submitted by G. J., London, England, involving the rabbits and crates, can be solved only by means of a trick. One of the crates must be large enough to contain one of the other five. Put an odd number of rabbits in one crate, say three. Put this crate into the larger one and place an even number of rabbits (say, four) between the smaller and larger crates. There will be an even number left over, in this case eighteen. Divide them into two groups of even numbers, for example eight and ten. Put three rabbits in the third crate, five in the fourth, one in the fifth, and nine in the sixth. It is now seen that the large crate contains seven rabbits (counting those in the smaller crate inside it), and all the other crates will also fulfill the conditions stated in the problem. I should like to see more problems in POPULAR SCIENCE MONTHLY, and a regular mathematics department. I have a few real stickers for some bugs to solve; for example: Bisect a triangle by a line tangent to a given circle.—W.W., New York City.

Can Some Bright Reader Enlighten R. L. K.?

IF SOMEONE has a theory concerning the source of light, I wish he would send it in to Our Readers Say. Here are some questions: Why does neon gas emit a red light when it is placed between two electric poles in a tube or bulb? Why does a filament emit light when it becomes heated? Is the source of this light in the atom? It is said that a book, for example, appears green because the substance used in the coloring absorbs all the colors from the white light of the sun except the green, which it reflects. Why do some substances reflect green light and others red? What happens to the rays that are absorbed by a substance? Let's hear your theories!—R.L.K., Denver, Colo.

Which Part of the Wheel Travels Farthest?

I HAVE a problem which always draws interesting comments: on a wheel are two points indicated by A and B in the drawing. As the wheel is rolled along the ground, which point travels the faster and travels the greater distance? I contend that both points travel at the same rate and cover the same distance because both revolve around the same axis. Most men say that point A travels slower than point B, but I can't see it. I wish that some of your readers would give me an answer, with the reasoning by which it is reached, to clarify my ideas on the subject.—H.W.M., Catasauqua, Pa.

Some Reflections on a Burnt-Out Light Bulb

I WANT someone to tell me whether or not I've discovered a new process. The other day I was testing a flash-light bulb and accidentally put 110 volts across it. I needn't tell you what happened: it burned out. But the flash deposited a layer of metal on the inside of the globe which would make a very efficient mirror. I opened the bulb and found that the film was very tough and durable. I think that the extreme heat vaporized the metal, which condensed on the cool glass. Anyhow, it seems much cheaper and easier than mixing the chemicals and going through the long, tedious process of silvering. I've tried *that!*—J.T., Wilson, N. C.

A Truckman Takes Exception To Fred Frame's Driving

I JUST read the letter of A.W.M., New York City, in Our Readers Say telling how he appreciated Fred Frame's article on safe driving. Fred Frame's rules for safe driving are all wrong. He has a great name for his successes on the race track, but he is unsafe on the highway if he follows his own rules. Ask some real truck driver who has mastered a large truck pulling heavy loads over all kinds of roads. If you can't find any in the East, come out to Wyoming or Montana; we have them here. A good truck driver is usually a perfect passenger-car driver. I was interested in the article because I am interested in trucking and have studied the different types of drivers.—R.A.S., Billings, Mont.

We Already Know What The Dispatcher Said

HERE is a simple but interesting problem that your readers may enjoy solving: A train running between A and B meets with an accident. It then proceeds at one nth of its former speed and arrives at B, b hours late. Had the accident occurred c miles nearer B the train would have been d hours late. Find the rate of speed of the train before the accident, and the distance from B at which the accident occurred, in terms of the other letters.—E.R., Pendleton, Ore.

Flame Isn't a State, It's a Process

FOR the information of M.B., Hunter, N. Y., who asks what state of matter is flame: Flame is a gas in the process of combustion. In order for any combustion to take place, the substance must be converted into the gaseous state and its temperature raised to the kindling point by the application of heat in the presence of oxygen. This can be demonstrated by holding a sliver of wood over, but not in direct contact with, a flame. When part of the combustible material in the sliver has turned to gas and its temperature has been raised to the ignition point, it will burst into flame.—C.H., Camden, N. J.

Ambitious Boat Builder Wants a Real Sailboat

ALTHOUGH I have been a subscriber or purchaser of POPULAR SCIENCE MONTHLY for about five years, never have I seen plans for an honest-to-goodness sailboat. I believe that if William Jackson would draw up plans for a sociable twenty- or twenty-five-foot catboat, or perhaps even a sloop with 200 or more square feet of sail area, it would go over big. In my opinion, there are just plenty of fans who would gobble up the chance to make such a craft. Sailing beats motor boating all to pieces. If you possibly can, squeeze this note into your Our Readers Say department and let the readers comment on it.—J.P., Lafayette, Ind.

High Authority on the Air Raid Bogey

I HAVE just read a newspaper account of an address by Major General James G. Harbord, chairman of the board of the Radio Corporation of America, in which he debunked some of the sensational pictures of air raids that will "destroy whole cities" in the future. I was reminded at once of your recent article on "Machines That Will Fight the Next War" (P. S. M., Oct. '34, p. 13), in which the same ideas were expressed. It made me wonder whether the General is another reader of your excellent publication, or whether this is just one more example of the authoritative character of your splendid feature articles. Along with the hullabaloo raised by the amateur chemists, model makers, and other hobby-riders, I think that some recognition ought to be given to the interesting and informative general articles you publish month after month.—J. C., New York City.

Thanks, We'll Have a Round-Trip Ticket

THE first thing I do when I get my copy of POPULAR SCIENCE MONTHLY is to turn to Our Readers Say. There is a good half hour of entertainment there. You can always find knockers, but most of the letters have a good word for you. Tell S. V. F., Cleveland, Ohio, that to protect his passengers in his rocket plane from ultra-violet rays all he would have to do is to put ozone between the walls of his plane instead of a vacuum. Why does not some one take a rocket plane and just enough fuel to get him to, say, Mars. When he got there he could ex-

tract the fuel for the return trip from the other planet. The scientists say that the planets all came from the sun, so they should have the same elements.—J.P., St. Louis, Mo.

Hope We're Not Giving Away Any Family Secrets

THE figures below, which appear to contain a message in code or cipher, were found by a friend and me while examining some valuable papers. We attempted to decipher it on the basis of repetition, frequency, and plain guesswork, but have been unable to get anywhere with it. The figures are on what appears to be an ordinary piece of letter paper, without a watermark, and are written in ink without spacing between lines. There is nothing else on it.

942293906259174689397998395946
345881905863899324252317537919
637962463489466213872262807539

Maybe one of your bright readers can figure it out for me.—W.J.G., Jersey City, N. J.

Value of Rat Power Is Definitely Established

L. H. T. of New York, in his answer to the question about the power that might be received from expanding metal, was a little stingy in ranking the metal with a fly, when probably it should have been ranked with a rat. The expansion of an iron rod one foot long if raised in temperature fifty degrees Centigrade is about .0005 feet. Now, the Young's modulus of iron is about 5,000,000,000 pounds per square feet transverse section; therefore, the force which the rod is capable of exerting, is 5,000,000,000 X .0005 pounds, which is equal to 2,500,000 pounds, instead of the 100 pounds that L. H. T. assumed. This force, however, would prevent the rod from expanding at all, but if the applied load is half of that, the expansion will be about half of its amount with no load. If the rod is 100 feet long, the half expansion total will be .025 feet, and the work done will be 30,000 foot pounds. If that is done in twenty-four hours the power will be .0006 horsepower, or .5 watts, which is considerably more than the .000011 watts which was given. And, now, for the rat-power rating which I arrived at. One horse power is equivalent to 746 watts, but a real, average horse can only do about three fourths of this, or about 573 watts, and for a horse weighing about 1,150 pounds, that is about .5 watts per pound. Hence, with the same ability rate, a rat weighing one pound would make a good substitute for the iron rod. If the rod were two square feet in section, you would have to have two rats.—J.B.D., Raleigh, N. C.

Astronomy Fan Makes a Modest Request

AFTER seeing what the chemistry enthusiasts have done to your magazine, one would almost think that he could get anything if he howled long and loud enough. Nevertheless, what I'm aiming at is this: a little dope on the casting and grinding of telescope mirrors and lenses would be well in line with the current interest in such things. It would help a lot of us who can't exactly afford astronomy books but can't get along without POPULAR SCIENCE MONTHLY.—I.N., Coeur d'Alene, Ida.

Taking Secret Pictures Is No Snap, Says He

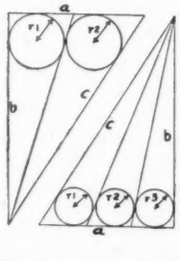
IN GIVING suggestions for taking secret pictures (P.S.M., Oct. '34, p. 27), you neglected to caution your readers that the results of this kind of work will not be what one generally considers satisfactory. Since the negatives usually require great enlargement, especially with the midget cameras commonly employed, it is necessary to have both a view finder for locating your object, and a range finder for setting the correct distance. Casual snapping is at best just a stunt.—H.F.G., Milwaukee, Wis.

Exploding Lead Puzzles This Home Chemist

WORKING in my laboratory the other day, I found it necessary to melt some lead for an experiment. I placed the lead in a crucible and heated it, but before it had all melted, the whole crucible of lead exploded and flew all over the room in small particles, solidifying as it shot through the air. I tried it again with the same result. Was this some special kind of lead? Perhaps expanding air bubbles in the lead caused it. If not, will some one put me straight? But don't tell me the atoms exploded!—A.H.A., Egg Harbor, N. J.

Have a Try at These Tricky Triangles

I WONDER if, among your readers, there are not some who would be interested in solving a couple of brain teasers suggested to me several years ago. First: given a triangle, to divide it (by a line through the vertex) into two triangles the incircles of which shall be equal (See Fig. 1). Second: to divide a given triangle by lines through a given vertex into three triangles whose incircles shall be of equal radii. If in each case the sides of the triangle are 7, 11, and 13, what are the lengths of the radii? Perhaps these problems are easily solved, but I'd like to see who can give the easiest construction which obtains the circles and makes possible the suggested computations.—O.J.B., Seattle, Wash.



Cats Will Appreciate This Handy Drinking Place

HAVING noticed the amount of space in a recent issue devoted to the lowly cat, I offer the following suggestion: A handy drinking saucer for cats can be made from a china tumbler-holder such as is seen in every bathroom and can be bought in any dime store. Screw the bracket to the wall about three inches above the floor. The holder can be removed for cleaning, and it has the advantage that it cannot be tipped over. And another thing: I noticed some time ago an item stating that half of a hollow rubber ball makes an excellent grease preventer around the transmission above the floor of an old car. I'll go you one better: Use a large-mouth rubber nipple. This is much easier and fits much tighter.—T.M., Charleston, S. C.

He Has a Model of an Unsinkable Submarine

I AGREE with P. S., New York City, about the models. Mr. Gommi is doing a fine job. I have made many models from your plans, including the *Saratoga*, *Sea Witch*, and rocket plane. I wish you would have Mr. Gommi or Mr. Clark make some plans for a model submarine, either working or scale, but preferably scale. I have a supposed working model that won't even sink. Your model could be made to scale with the others in the series, or larger.—T.C., Bronxville, N. Y.

The Bullet-Problem Bug Claims Another Victim

JUST another victim of the bullet-problem epidemic. Suppose that Old Man Earth were to shoot an apple off the head of the Man in the Moon with a rifle. Would 100 per cent of the force ordinarily exerted in producing the kick be converted into heat against the breech? Another: A Winchester .22 long-rifle cartridge with a forty-grain bullet has a muzzle energy of 174 foot pounds. Now, suppose that a second forty-grain bullet is fitted into the primer end of the cartridge, the powder charge remaining the same, and this double-bullet cartridge is fired in the center of a barrel open at both ends. Would either bullet have a muzzle energy of 174 foot pounds?—H.B. G., Portland, Ind.

Looks in Vain for "Well-Known" Phenomenon

THE article on "Rainbows and the Sun's Green Flash" (P. S. M., Oct. '34, p. 52) is the kind of thing we have been waiting for. It has always been a pleasure to me to trace such phenomena as the green flash and learn their causes. In this pursuit I come across accounts of manifestations of physical optics which are described as being everyday occurrences but which I have not been able to recognize. The most interesting of these is Hydinger's Brushes, described by Helmholtz in the paper published in the Harvard Classics. He claims that it is a well-known phenomenon, but I have not found anyone who has ever heard of it. Although Helmholtz says that any one who looks for it can see it, I have not found this to be the case, and concluded that I am not sufficiently well informed to know exactly what to look for. I am wondering whether some of your readers can help me to find this interesting display of polarized light. Another phenomenon that has aroused my curiosity is the green line that is said to be visible in the light reflected from the sky.—L.A.M., Sault Ste. Marie, Mich.

Groaning Board Becomes a Talkative Table

IS THERE really such a thing as spiritualism? Recently, a friend showed a group of us a great little party trick and had a wooden table knock out answers to the questions we put to it. The table told the correct ages and other facts about all the people in the room. Naturally, we all suspected a trick. However, a few nights later, with the scene changed entirely, I tried the trick with several people who had not been present at the previous seance. To my own astonishment, as well as that of my friends, the table rose and tapped out answers as the other had done. This time it was absolutely impossible for a trick to be involved. Now, is there a scientific solution to this problem? What is there in a human body to make a table rise and fall, and tap out answers, mostly correct, to the many questions asked of it? Do you know?—E.J.W., Brooklyn, N. Y.

IF THE TELEPHONE WERE NOT THERE!

MANY times each day you reach for the telephone on your desk at the office or beside your easy chair at home. It is an old and trusted friend. You scarcely give a thought to what it means to a busy day.

Yet suppose the telephone were not there! Suppose—for a week—or a month—you could not call anybody by telephone and nobody could call you!

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BELL TELEPHONE SYSTEM

POPULAR SCIENCE Monthly

JANUARY 1935 VOL. 126 No. 1

RAYMOND J. BROWN, *Editor*

Streamlined Trains

HERALD NEW SPEED ERA

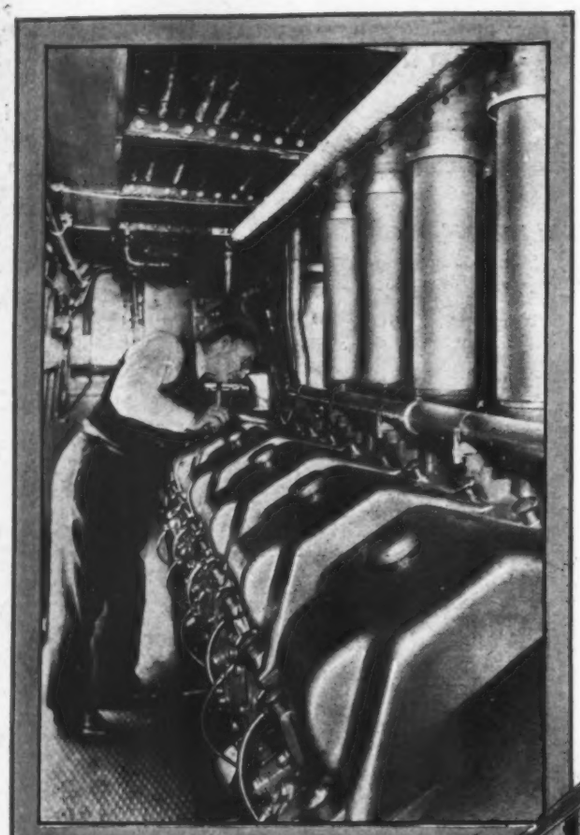
By Alden P. Armagnac

NEW TRANSCONTINENTAL RECORD BREAKER ON RAILS
This photograph of the Union Pacific's streamlined train, M-10,001, was snapped during its recent record-breaking dash from Los Angeles to New York

WHEN a streamlined train whizzed across the United States in less than fifty-seven hours, a few weeks ago, its feat marked the beginning of a new era in railroading. Not only had it shattered every world's speed record for a fully-equipped train, but still more impressive, to the railroad executives aboard, was the fact that the spectacular test run had proved such speeds practical for everyday passenger service. Hardly had the Union Pacific's projectilelike, six-car aluminum train, the *M-10,001*, glided to a stop at the New York terminus of its transcontinental dash from Los Angeles, when officials of the line announced that they expect to have a fleet of three such trains in actual operation by the end of the winter. Regular scheduled runs between Chicago and the west coast will be made weekly by the *M-10,001* and by two nine-car trains of similar design, now under construction. The fastest trains now require fifty-five hours for the trip, but the new ones will make it in forty hours or less. Thus they will slash a whole business day from the time of a coast-to-coast journey by rail.

Today, bullet trains, like the Union Pacific's *M-10,001* and the Burlington's *Zephyr*, another recent record-breaker, are regarded as curiosities by throngs that flock to see them wherever they are exhibited. Tomorrow, they will be a standard means of travel. Already, they have passed triumphantly through their experimental stages, and it now seems to be a race to see who can build them fastest.

Two bullet trains are nearing completion, at this writing, for the Baltimore and Ohio Railroad—one to be pulled by Diesel power, the other by a revamped and streamlined steam locomotive. Two trains duplicating its famous *Zephyr* are under construction for the Burlington System. The Boston and Maine has ordered a streamlined train, as has also the New Haven. Both the Illinois Central and the Gulf, Mobile,



Above, the 900-horsepower Diesel engine that drove the new train

vation in streamlined-train equipment.

Outside, the train is painted canary yellow and brown. The color scheme was not a chance selection, but was chosen as a safety precaution. Tests demonstrated this combination to have the greatest long-distance visibility. An ear-piercing siren for cross-country use, and one lower-pitched for metropolitan zones, announce the approach of the flyer. At night the regular headlight is supplemented by another that casts a vertical beam as a warning to motorists nearing a crossing.

One of the most striking impressions of an observer seeing the train for the first time is its lowness. Skilful design has dropped the center of gravity twenty inches nearer the rails than in standard coaches. It is this, that enables the train to round curves at high speed without danger of jumping the tracks. To a passenger, there is a surprising freedom from swaying and lurching, even on sharp curves.

Accommodations for 124 passengers are in keeping with the train's mechanical innovations. Pullman-car appointments include such novelties as individual washstands and mirrors that unfold from the walls of the compartments; sliding aluminum curtains, working like the roll tops of desks, replace the usual ones of cloth and completely enclose a berth; folding ladders, lowering at a touch, for the convenience of a passenger entering an upper berth. A curtain drawn about the top of the ladder permits the upper-berth occupant to rest his feet upon it and dress or undress in security and comfort.

To an engineer, however, the most fascinating car of the train is the power car. Here is the Diesel-electric plant that drives the train—a miniature, self-contained power station that generates electricity and then uses it to run motors at-

Left, rear view of the Burlington's streamlined Zephyr showing how the tail is rounded off to minimize the drag of train's air currents

and Southern plan bullet train service. Still others are likely to follow in the near future. No longer are streamlined trains an experiment.

Old-time railroad men may well look askance at these worm-shaped, bullet-nosed apparitions of the rails. The driver of a train has ceased to be an engineer—he is a motorman. His locomotive has become a power car. A streamlined train is said to have a maximum speed and a cruising speed, as if it were an airplane. Outlandish words to a veteran railroader, they show how the sciences of motor engineering and aerodynamics have combined to provide the railroads with a vehicle so strange that it demands a whole new vocabulary.

The *M-10,001*, most completely equipped streamlined train yet put on rails, typifies this new departure in transportation. Like its experimental predecessor, the three-car *M-10,000*, it resembles an elongated airplane fuselage. Since the end of each car overlaps the next, to give a smooth air flow and decrease wind resistance, it is hard to tell at a glance where one car begins and another ends. There are six in all: the power car, a mail and baggage car, a buffet coach, and three Pullman sleepers, the last being a decided inno-

ALUMINUM CURTAINS ENCLOSE BERTHS IN NEW TRAIN

Sleeping cars on the M-10,001 have sliding aluminum panels that convert each berth into a compartment. A platform makes dressing and undressing easy. At the right, the same compartment as at left with the aluminum curtain rolled back

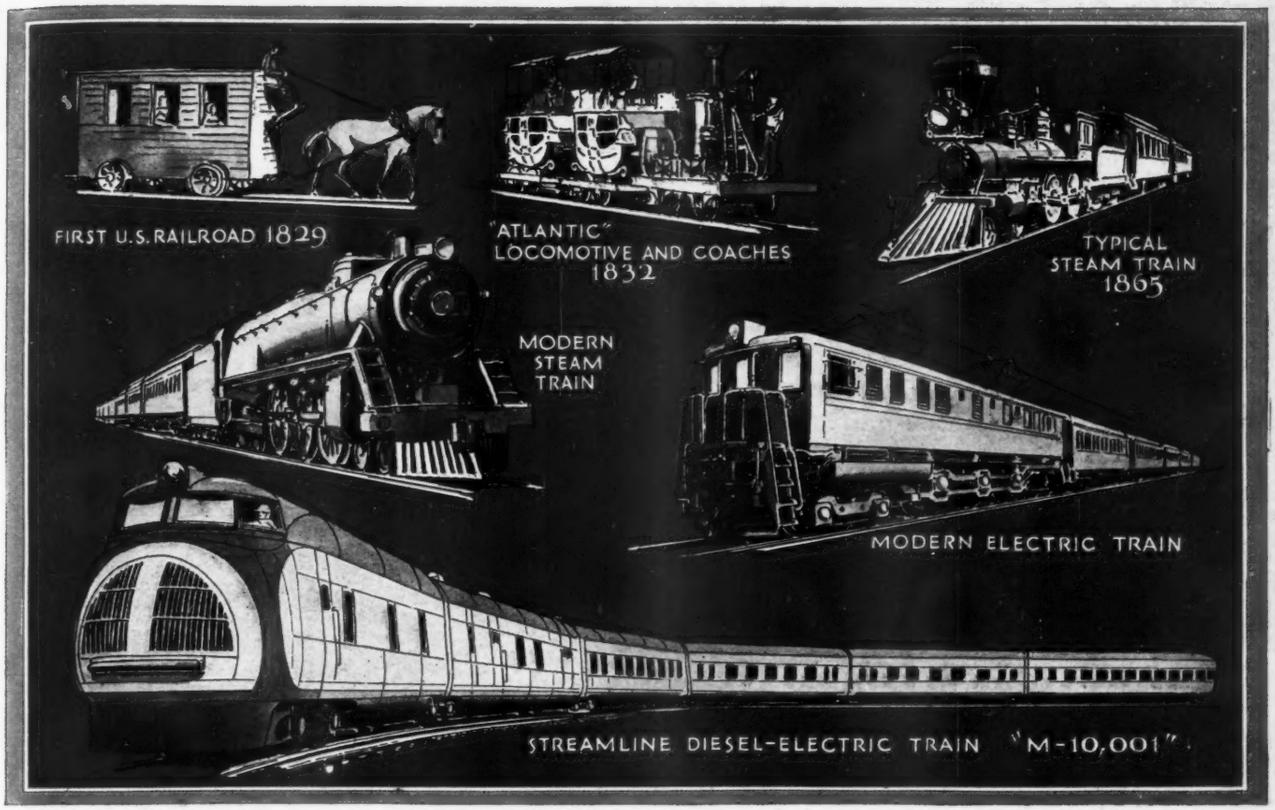
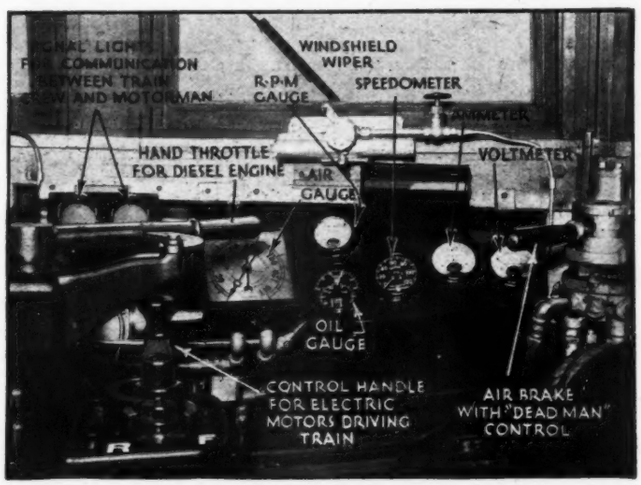


Illustration above shows the evolution of the railroad, from the horse-drawn street car, to the two-mile-a-minute train of the present



Controls like those of an automobile are found in the bullet train

tached to the driving wheels of the train.

A 900-horsepower, twelve-cylinder Diesel engine, burning low-cost fuel oil, is the source of the power. Patterned after the engine of a submarine, it is said to be the first of its type ever installed in a passenger train. To an engineer, its V-shape, its two-cycle design, and the enormous pressures carried in its cylinders stamp it as a radical departure from standard practice. Even a layman can appreciate the amazing compactness of the engine, which, despite its power, occupies a space only twenty feet long, eight feet high, and less than six feet wide. Rakish funnels, protruding through the roof of the power car, serve as exhausts, replacing the smokestack of a conventional locomotive.

Coupled to the Diesel engine is a generator, and the electricity it produces runs the four traction motors on the trucks of the power car that propel the train.

Over this maze of machinery presides the motorman, clad in spotless white overalls, and presenting a striking contrast to the usual picture of an engineer. Sitting at the right-hand side of a cab that is elevated above the rounded nose of the train, he has an unobstructed view of the track ahead. Within easy reach of his left hand is a throttle that regulates the Diesel engine, and an electric control handle, not unlike that of a trolley car, that governs the speed of the train. At his right is the air-brake valve with its "dead man" control—a safety device upon which the motorman must keep either his hand or foot while the train is moving. Should he relax his hold on one or the other, for any reason, the throttle closes and brakes go on automatically, stopping the train. Dials on an instrument board enable him to keep tab on the engine and motors, and red and green signal lamps permit intercommunication with the train crew. A speedometer, an unusual train accessory, shows the speed in miles per hour. Not only do the controls resemble those of an automobile, but they are handled as simply. A duplicate set is provided at the left-hand side of the cab for a second operator.

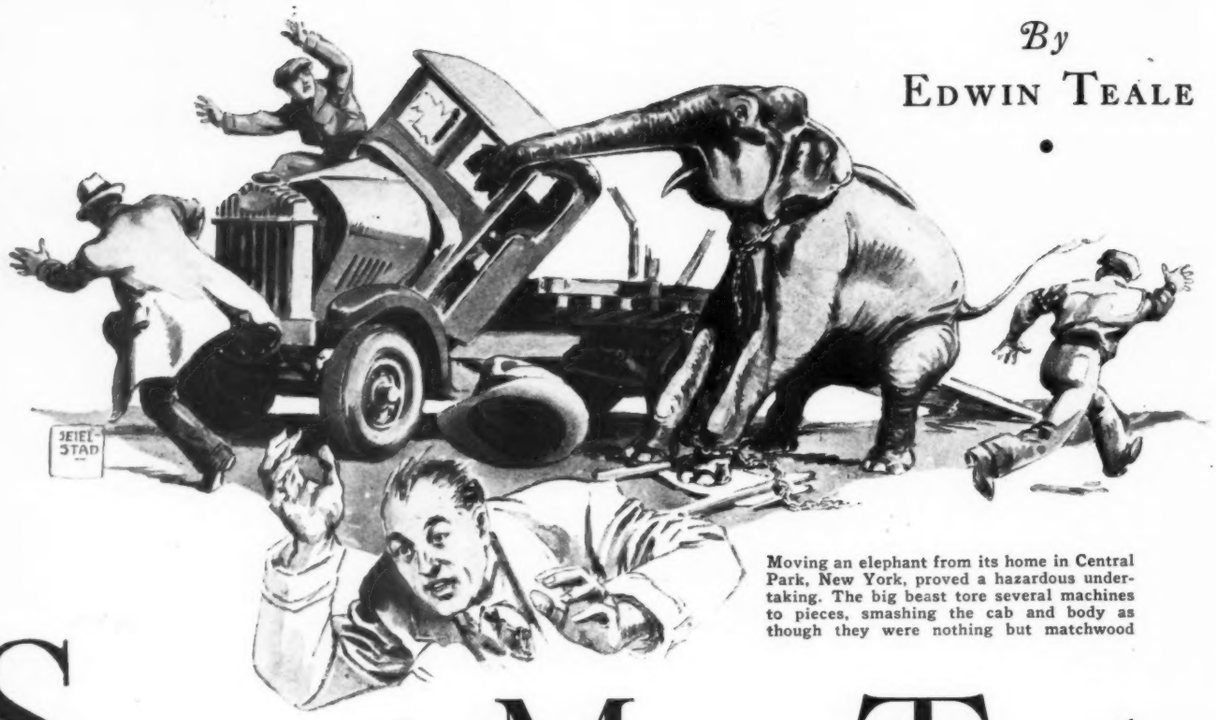
This, then, was the new-type train that swept out of Los Angeles one Monday night at ten P.M., Pacific Time, and started east in a race against the clock. Passing over the plains after leaving Cheyenne, Wyo., the man at the controls opened them wide to see what the train could do. The speedometer needle crept to 120 and hung there, while the *M-10,001* clipped off two miles in one minute flat, a record that has been equaled by no other fully equipped train in the world.

Into Chicago whizzed the streamlined train, just thirty-nine hours out of Los Angeles, and all previous records for this 2,364-mile run went by the board.

From Chicago to New York, in the words of the motormen who ran it in two-hour shifts, the *M-10,001* "just loafed along." Nevertheless it beat the time of the crack Twentieth Century Limited by twenty minutes. The streamlined train arrived in New York City at 9:55 Eastern Time, Thursday morning, having completed the transcontinental dash and made several stops en route in the amazing time of fifty-six hours and fifty-five minutes. Averaging nearly sixty miles an hour, the train had lowered the railroad coast-to-coast time by fourteen and a half hours.

Such trains as this are the railroad's answer to the airplane. They represent so radical a change in style of transport that one comparable hardly can be found in railroad history. As the railroads evolved, there have been certain major steps of progress, the change from wood-burning locomotives to coal burners, for example, and the rise *(Continued on page 97)*

By
EDWIN TEALE



Moving an elephant from its home in Central Park, New York, proved a hazardous undertaking. The big beast tore several machines to pieces, smashing the cab and body as though they were nothing but matchwood

Stunts *by* Motor Trucks

FORTY-FOOT whales, hundred-ton statues, speed boats, trolley cars, elephants, around-the-world airplanes, roadside diners—all these have ridden on the motor trucks of the Gerosa Haulage and Warehouse Company. This New York organization, a concern unique in America, specializes in handling the biggest, the heaviest, and the most unwieldy objects hauled by truck.

Right now, for instance, its trucks are rolling through city traffic bearing immense 120-ton trusses of steel. They will form the skeleton of a new skyscraper at Radio City. By applying science to the designing of special equipment, the organization is breaking records and making trucking history.

Ninety feet below Prospect Park, in Brooklyn, N. Y., a few years ago, engineers came to the end of tunneling operations for a new subway. Usually, the crown shields, or great metal rings that protect workers digging at the nose of a tunnel, are turned to one side and buried in concrete at the end of a job. In this case, the company had another tunneling job which it was to begin immediately a mile and a half from the spot. To make new shields would require three months and cost $40,000. Could the Gerosa company bring the two 326,000-pound rings to the surface and transport them a mile and a half? It could and did.

Burrowing straight down, workmen gradually jacked up the shields to the surface, raised them on cribbing, built a heavy platform beneath them, and then lowered them onto special gooseneck trailers. One at a time, the rings, towering twenty-five feet in the air, were towed through the streets, their immense weight distributed over eight wheels with huge cushion tires. The trips were made after ten o'clock at night with linemen from the street-car company going ahead to cut the trolley cables and let through the huge rings riding on gigantic trailers.

Those trips still stand as an all-time record for the heaviest objects ever hauled on trailers through a city street. On such assignments, the experts of the Gerosa company go over the pavements looking for weak places and study maps showing the exact location of water mains and manholes before they pick a route for the trucks.

Weight, however, was a minor consideration in one of the most exciting jobs ever undertaken by the company. Last winter, CWA workers began improvements on the buildings in Central Park, New York. Chang, a young female elephant, had to be moved to new quarters in Brooklyn while the work was going on. As

Above, truck moving the great metal ring that is used to protect tunnel workers—heaviest object ever carried on a trailer

Chang weighed less than three tons, the task seemed easy.

Another trucking company first took the assignment. Its driver brought a new machine out and backed it up to the elephant house. Half an hour later, the machine limped away almost dismantled. Chang had torn the side structure to pieces, had demolished the cab, and had left little more than the chassis. A second concern took the contract. Again the elephant smashed the woodwork on the truck and battled forty men in resisting efforts to get her aboard.

ONE after the other, seven trucks drove into Central Park and drove out again defeated. In one case, Chang picked up the cab of a truck and hurled it aside as though it had been a match box. In another instance, she tore the panels from a van. Finally, the trouble shooters of the Gerosa company were handed the job of getting the elephant to Brooklyn.

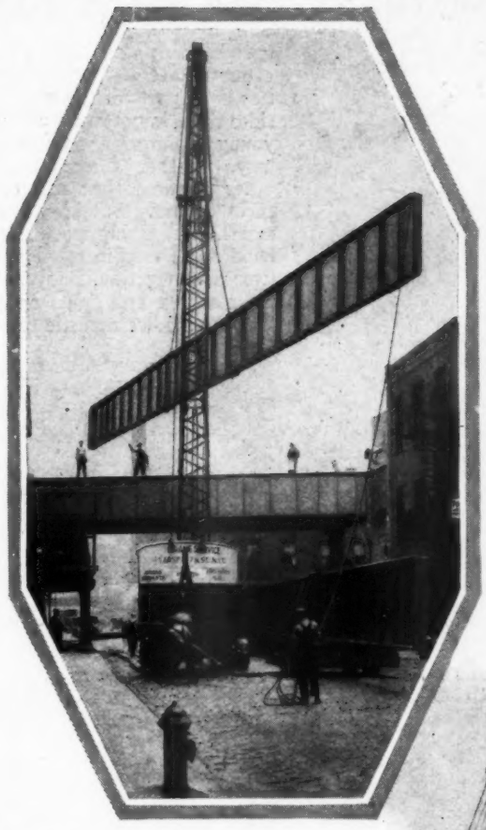
When their truck swung into position, an army of men was on hand to help. But none of them was needed. The truck had been fitted up to resemble a tent. Above the twelve-and-a-half-foot side racks was an arched canvas cover and on the floor of the truck was a thick layer of straw. Around the rear of the elephant, the men placed a heavy harness hitched to a power winch. Every time the animal began to slow down on the heavy planking leading into the truck, the winch started and gave her a boost.

Once inside, she was chained to the floor and her trunk fastened securely to a heavy belt encircling her middle. In this way, she started on the twelve-mile ride through traffic and across the East River to the Brooklyn Zoo. The excitement began soon after Central Park was left behind. A near blizzard arose and snow piled up on the canvas cover.

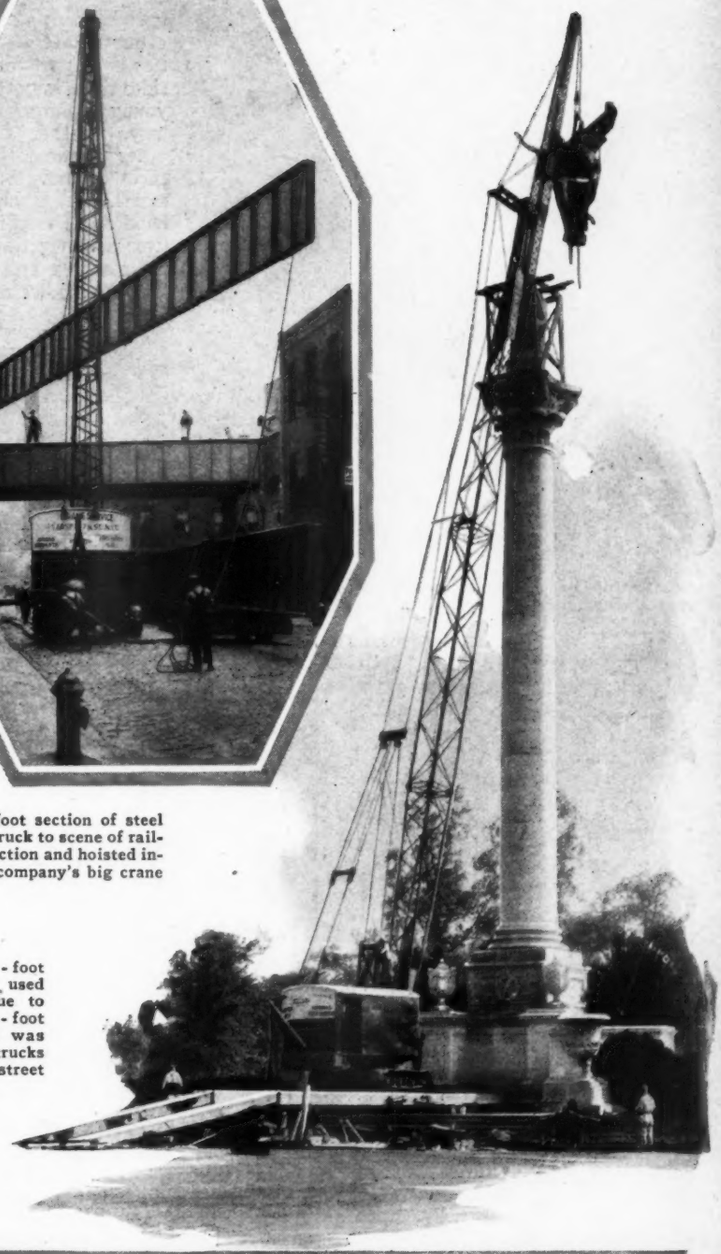
Then Chang broke her trunk free, ripped the canvas and began attacking the uprights.

A keeper riding with her would tap her trunk with a stick every time she grabbed an upright, thus preventing serious damage. But the driver was on the verge of the jitters when the trip was over. During the last few miles, Chang had been writhing her trunk around the side of the cab, snorting in his ear, and making passes at the steering wheel. All the way across the Manhattan Bridge, spanning the East River, she had swung her trunk from side to side trying to grab the ironwork of the bridge as she went by.

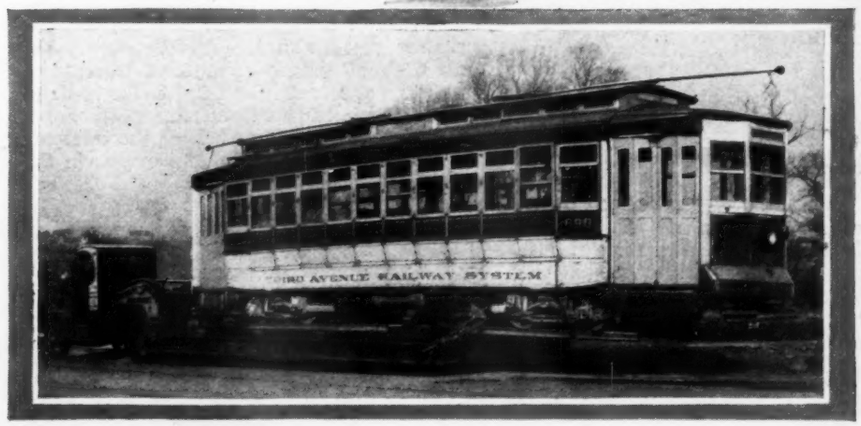
Compared to that ride, hauling a forty-foot captive whale was a cinch. The whale reached New York in a special seventy-two-foot exhibition car at the end of a transcontinental tour. It had died and drums of formaldehyde had been injected to preserve it. By the time it reached New York, it weighed, with its car, more than ninety tons. Then it was discovered that the car was so long it couldn't round the sharp curves on the railroad leading to *(Continued on page 107)*

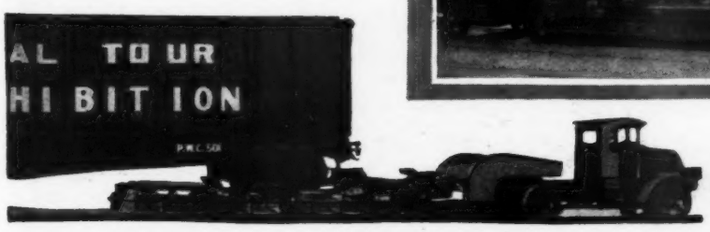


Above, 100-foot section of steel brought by truck to scene of railroad construction and hoisted into place by company's big crane



Right, 110-foot steel boom used to lift statue to top of fifty-foot column. It was moved by trucks along city street





Above, street car loaded on truck and trailer is moved six miles across country to new tracks. Left, how trucks and trailers were used to move whale in seventy-two-foot car

CLASSROOM EXPLORERS STUDY JUNGLES

These ship models and compasses are used by exploration students in classroom

WITH a veteran explorer as guide, Harvard students, in the only school of its type in the world, can make exploring trips to the Arctic and to equatorial jungles without leaving the classroom. The school, known as the Institute of Geographical Exploration, is supplied with all the equipment necessary for safe travel and for bringing back scientific data. Prospective explorers may practice aerial photography and mapping with the latest available cameras, learn how to navigate by land, sea and air and how to check a compass. They receive radio instruction on a set so powerful that it can communicate with exploring parties in all parts of the world. Besides these important studies, the young explorers are taught geology, weather forecasting, and other sciences that will enable them to carry out scientific researches. Two ship models are on hand to be used in solving problems of navigation. Buoys, channel markers, and lights on ships give the studies realistic touches.

Composite air photograph of Cape Cod made to teach students how to prepare air photos

MAGNIFIER IN PENCIL

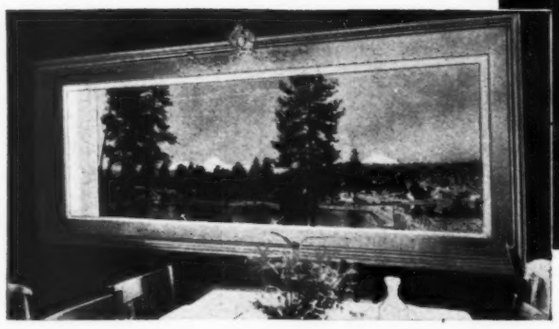
A MECHANICAL pencil, combined with a magnifier, has just made its appearance. The pencil is a regular propel-repel model that takes the standard size leads. It has a crystal-clear half that magnifies fine print.

U. S. DYES MOSQUITOES

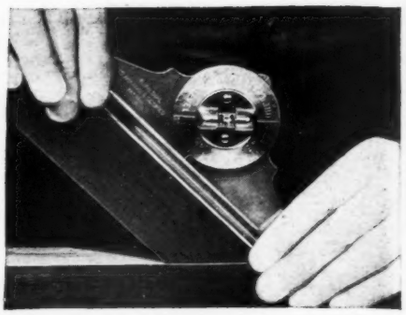
PINK mosquitoes form the latest addition to the U. S. Government's equipment for fighting insect pests. The Department of Agriculture sprays the mosquitoes with dyes, in a study of their movements.

REALITY SEEMS PICTURE BUT PICTURE LOOKS REAL

A VIEW that looks like a picture, and a picture that looks like a view, are shown in the two accompanying photographs. Admiring the landscape from the window of his hotel at Bend, Ore., the proprietor decided to put a picture frame around the window. Within this artificial setting, the visitor sees the Deschutes River and, beyond, the peaks known as the Three Sisters. Conversely, the Auto Club of France mounted a transparent photograph of mountain scenery, ten feet high and eight feet wide, and set in a frame resembling a window. Illuminated from behind, the transparency gives the effect of an Alpine view in the midst of Paris.

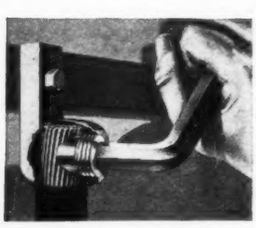


Above, a picture that looks real and left, a real view that makes you think it is a picture



LEVEL FOR ALL WORK

HORIZONTAL surfaces, and those at all angles of pitch, can be checked by a new level. The bubble tube is mounted in a barrel that can be rotated at will. To check a forty-five degree beam for example, the barrel is turned to this reading and the level placed against the beam. If the latter is true, the bubble in this unusual level will come to rest at the center.



Above cutaway view of wrench in use, at left, making solderless connection

SOLDERLESS CONNECTOR

A NEW solderless connector for electrical work eliminates the use of blowtorch and soldering iron, and assures a perfect connection. The powerful leverage of the socket-head wrench, turning a hollow set-screw, provides a positive mechanical and electrical connection. The connector is manufactured in eight models that fit all wire sizes.

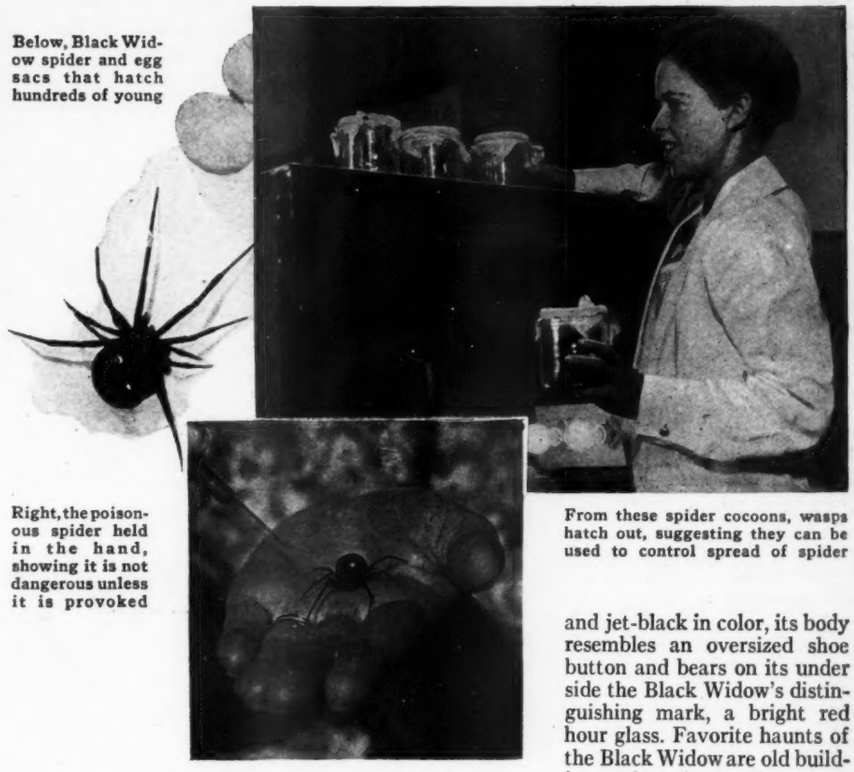
Inventor of light-ray gun exhibits model of his strange weapon that blinds victim

GUN SHOOTS LIGHT RAY INSTEAD OF BULLETS

SHOOTING light rays instead of bullets, a mercy gun, devised by a French inventor, was recently demonstrated before military officials of that country. The strange device is intended to throw so dazzling a glare that it temporarily will blind an opponent, thus rendering him helpless until he recovers his vision. A hand-sized model of the light-ray gun, exhibited by the inventor, fires cartridges that are said to emit a light of several million candlepower when the trigger is pulled, igniting a secret mixture resembling photographic flashlight powder but burning with many times its brilliance. A reflector concentrates the beam, which lasts for twelve seconds. Animals upon which the rays were directed, in tests, were reported to have fallen to the ground, blinded and paralyzed, and to have regained consciousness only after several minutes. The inventor proposes that gigantic forms of the light-ray gun, using reflectors of 150-foot diameter, could be used to combat air raiders. Pilots of the hostile machines could be blinded by the glare, he maintains, and would lose control of their craft and crash to earth. Use of the mercy gun against infantry is also said to be a possibility.

WASPS TO FIGHT SPIDER MENACE

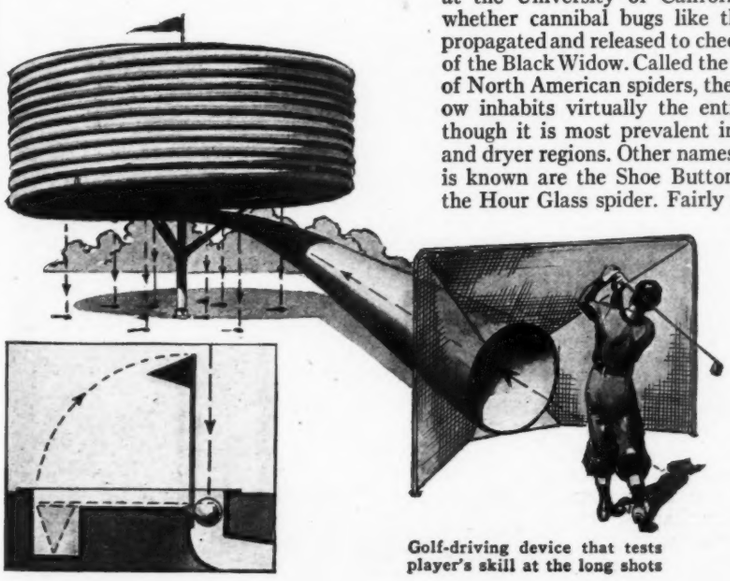
Below, Black Widow spider and egg sacs that hatch hundreds of young



Right, the poisonous spider held in the hand, showing it is not dangerous unless it is provoked

From these spider cocoons, wasps hatch out, suggesting they can be used to control spread of spider

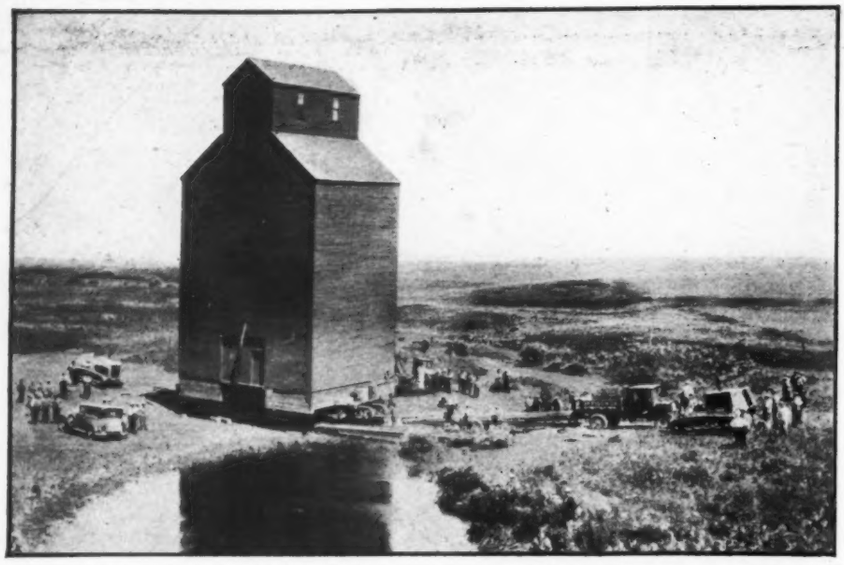
MILLIONS of tiny wasps may be mobilized to fight the new menace of the Black Widow spider. With the country alarmed by the remarkable spread of this poisonous creature in recent months, scientists have been seeking a means of control. A western research worker, hunting the cocoons of the spider, found a few riddled with holes as if another insect had bored into them. When the cocoons hatched in laboratory incubators, not spiders but tiny wasps emerged. Parasitic wasps had laid their own eggs within, and the wasp larvae had eaten the spider eggs. Another parasite was later discovered, a fly resembling a large gnat, whose young also eat the spider's eggs. Experiments are now being conducted at the University of California to learn whether cannibal bugs like these can be propagated and released to check the spread of the Black Widow. Called the most deadly of North American spiders, the Black Widow inhabits virtually the entire country, though it is most prevalent in the milder and dryer regions. Other names by which it is known are the Shoe Button spider and the Hour Glass spider. Fairly large in size and jet-black in color, its body resembles an oversized shoe button and bears on its under side the Black Widow's distinguishing mark, a bright red hour glass. Favorite haunts of the Black Widow are old buildings, where it usually weaves its web in corners near the floors, and the spaces beneath houses and sidewalks. The web is a criss-cross mass of silk threads. Drop for drop, the poison of the Black Widow is more deadly than rattlesnake venom. Popular report blames the spider's bite for numerous deaths. However, contrary to a popular misconception, the Black Widow will not deliberately bite a human being; it does so only in self-defense or when its web is disturbed. If a person in a dimly-lit room, for example, accidentally pokes a finger into its web, the spider dashes from its hiding place and bites, as it does when an insect or any other object disturbs the strands. It will also bite when squeezed, as in donning clothes in which it may be lurking. However, a Black Widow may be held in the hand with comparative safety. The sudden increase in numbers may be due to unusually dry years or its natural enemies may have been destroyed. If so, experiments now under way may replace these enemies. On the other hand, scientists say, the apparent increase of the spider may be due to a more general recognition of the spider by the public.



Golf-driving device that tests player's skill at the long shots

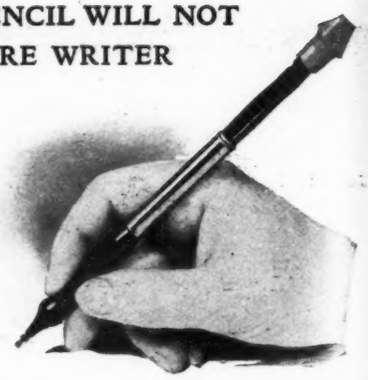
TESTS SKILL OF GOLFER

LUCK plays no part in the operation of a new device known as a rotary golf machine, invented to test driving skill. Standing inside a small room, the golf devotee will be able to drive without breaking mirrors or windows, and obtain a sure test of his driving ability. To try his skill, the golfer steps up in front of a chute and tees off. The ball travels into a cone-shaped device circling upward in a rotary path, and contacting sensitive mercury switches every fifteen yards. These switches make tiny red lights flash on so the golfer can tell how far the ball is going. When it stops, it drops into a spout and lights give the yardage.



Towed by two tractors, this huge grain elevator was moved eleven miles across the country

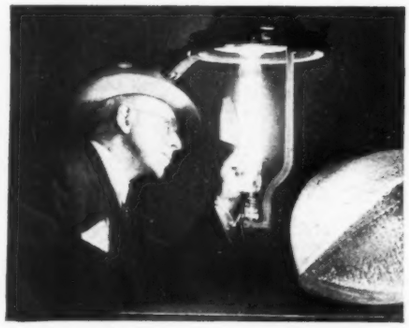
PENCIL WILL NOT TIRE WRITER



DESIGNED to prevent writing fatigue, a pencil recently placed on the market has its lower end shaped to fit the fingers. This design makes it almost impossible to write at a cramped angle that might tire the hand, and prevents the fingers from slipping down toward the point. The pencil contains a reserve supply of the leads.

GRAIN ELEVATOR TAKES AN ELEVEN-MILE TRIP

A TOWERING grain elevator went on an eleven-mile journey, the other day, in one of the most unusual of moving jobs. To avoid blocking roads, it was taken directly across country over rolling and hilly farm land, streams and railroads. The eighty-foot-high building traveled upon an endless-tread carriage, with two ten-ton tractors providing motive power. Temporary bridges were built to help the building over streams and railroads. The journey was completed successfully in four days without damaging the structure's walls.

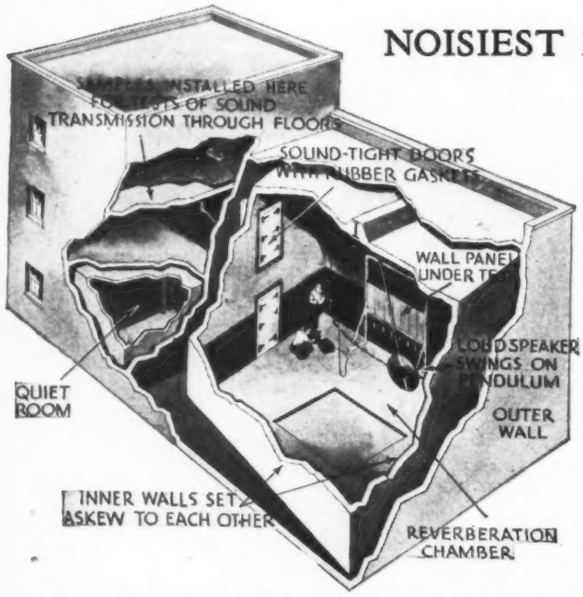


New High-intensity mercury-vapor street lamp that gives almost pure white light

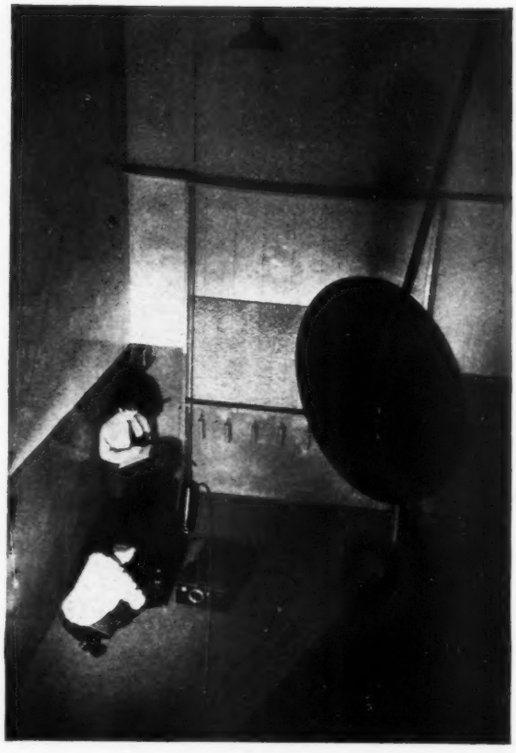
MERCURY LAMPS GIVE NEAR-WHITE LIGHT

THE FIRST high-intensity mercury-vapor lamps ever employed in street lighting in this country were installed recently in Lynn, Mass. Instead of the greenish-violet light given off by low-pressure mercury tubes, the new lamps emit rays that are nearly white. This is accomplished by combining an ordinary incandescent bulb with a high-intensity mercury tube as shown at left. As the tube heats up, pressure is built up inside it and it gives off whitish rays which combine with the red and yellow rays from the incandescent bulb.

NOISIEST ROOM TESTS SOUNDPROOF WALLS



Left, acoustic laboratory where sound-absorbing wall materials are tested. The "noise room" is seen in the foreground. At right, the loudspeaker swings on pendulum

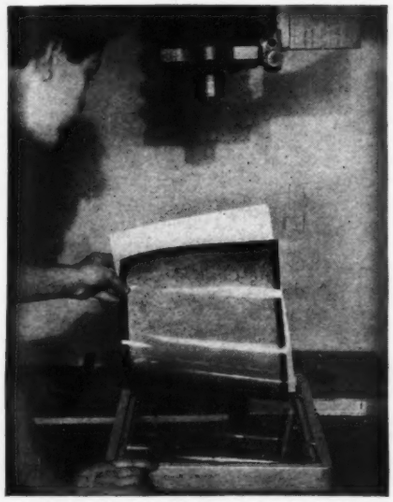


To A testing chamber of an Eastern acoustical laboratory might well go the dubious honor of being the noisiest room in the world. A bedlam of ear-splitting noises produced here tests the performance of sound-absorbing wall materials. Microphones in the chamber, and recording instruments in an adjoining room, enable engineers to make tests without being exposed to the din, which is produced by a loudspeaker hung on a pendulum. The swinging speaker distributes the sound evenly, and walls set slightly askew to one another minimize interference that would otherwise be set up. In contrast with the racket of this reverberation chamber, a "quiet room" constructed nearby is practically without sound.

Section of photograph made with new screen showing unusual etching effect

PHOTOS LOOK LIKE ETCHING

PHOTOGRAPHS that look like etchings are obtained in a process just perfected by a California expert. This striking effect is attained by the use of a special transparent screen bearing an imprinted pattern of fine lines, which is inserted in the negative holder of the camera with the plate or film, and through which the picture is taken. Development makes permanent the etched effect on the negative. An alternative method permits contact prints or enlargements showing the etched effect to be made from ordinary negatives; in this case, the special screen is simply placed against the sensitized printing paper and the print or enlargement is made in the usual way without losing etched effect.



Placing screen in contact with sensitized paper

PILL DISPENSER FITS POCKET

OPERATED by turning its rounded bottom with the thumb, a new pill dispenser delivers one tablet at a time. A spring forces the tablets downward into contact with a metal cup. As the cup is rotated, it picks up the tablet.

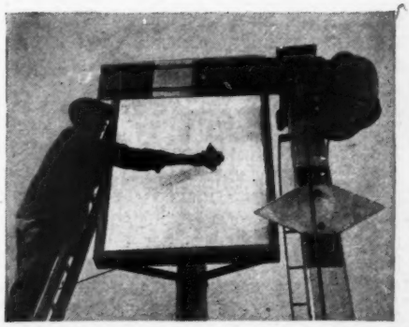
MECHANICAL MAN HEARS AND SPEAKS

A MECHANICAL man that understands and obeys spoken commands has just been brought to this country and placed on exhibition by its British creator, Professor Harry May of London. When such orders are given as "Wake up," "Stand up," and "Raise your right arm," the robot promptly obeys, also firing a blank-cartridge pistol when directed. When asked, "How old are you?" it replies, "Fourteen years," in a sepulchral voice. Directions are given in carefully couched phrases, the automaton remaining motionless if the wording is changed. Its brain is an electrical oscillograph that records and recognizes certain patterns of voice modulations, operating the motor-driven figure and its loudspeaker voice through selective relays. Before this mechanism was perfected, the figure occasionally played strange pranks, according to May. Once it mauled an assistant and on another occasion it shot unexpectedly at its creator, as if endowed with the malevolence of a mechanical monster of fiction. At present, however, the robot is on its good behavior and runs docilely through its repertoire of twenty or more answers to questions, also executing a wide variety of motions on request.

NEW KEYBOARD AIDS GUITAR PLAYER

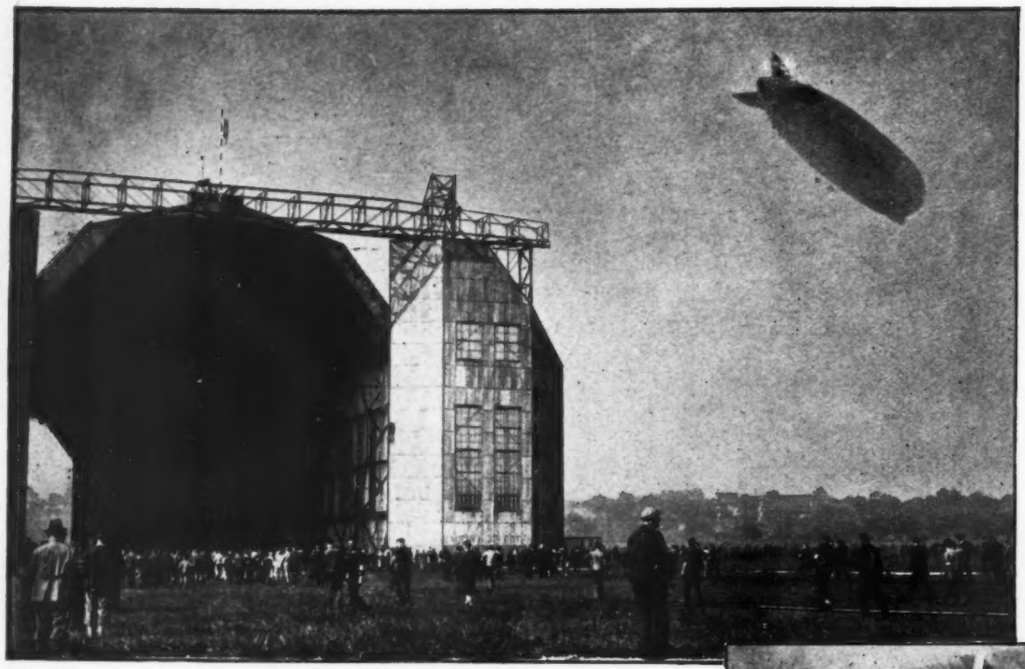
TO SIMPLIFY the task of fingering a guitar, an Oklahoma man has invented a keyboard designed to fit over the neck of the instrument. The attachment contains 108 keys, corresponding to the eighteen tones that can be sounded on each string. In playing the guitar, a performer merely presses one of the smooth topped keys instead of pressing directly upon the strings. Keys comprising a chord are painted so they can be distinguished.

With this keyboard, a guitar is played without the fingers touching keys



FROSTED GLASS GUARDS RAILROAD SEMAPHORE

LEST an engineer fail to see a signal camouflaged by foliage, or interpret its meaning correctly, a British railroad is fitting its semaphores with safety-first screens of frosted glass. Against one of these white backgrounds, the position of the signal arm can be seen at a considerable distance.

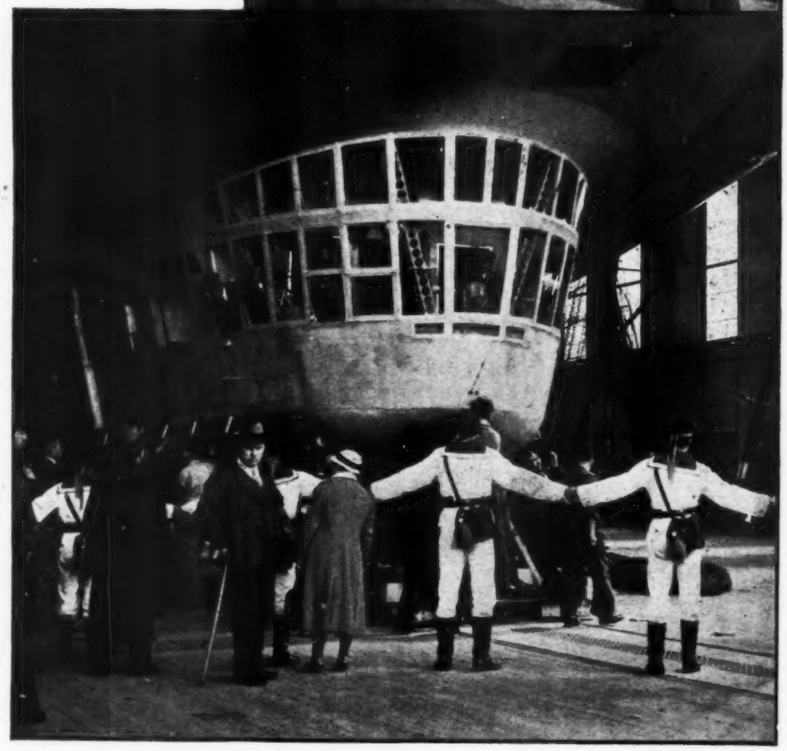


Left, remarkable picture of the *Graf Zeppelin* leaving its port at Friedrichshafen and starting on one of its regular trips to far-away South America. It makes the round trip every two weeks during the summer and fall. To date, seventy-one trips have been made

Below, workmen are removing ballast from the gigantic airship just before its departure. This is done to enable the ship to be launched into the air

Regular Airship Flights
Berlin to New York
Will Start Next Summer

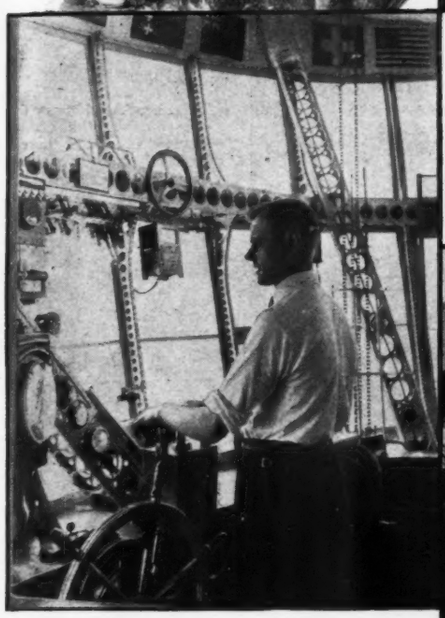
HAVE airships stolen a march on airplanes, in the race to establish air passenger lines across the seas? Following the lead of the *Graf Zeppelin*, pioneer of the South Atlantic sky trail, lighter-than-air craft seem about to add the North Atlantic, and possibly other oceans as well, to their conquests. For four years the *Graf Zeppelin* has flown between Friedrichshafen, Germany, and Pernambuco, Brazil, with ferryboat regularity, totaling seventy-one transatlantic crossings at this writing. In these Atlantic crossings, it has carried 10,000 passengers, exclusive of its crew—a record unique among the world's aircraft. Photographs on these pages show what a voyage on this air liner is like, and give a foretaste of what Americans may soon look forward to. Nearing completion in Germany, the *LZ-129*, world's largest airship, will make the dream of a U. S.-to-Europe airline a reality, if present plans mature. By early summer the huge Zeppelin is scheduled to start regular commercial flights between this country and Germany. Authority has been granted to use the naval air station at Lakehurst, N. J., as the United States terminus of the transatlantic line, and the U. S. Post Office Department is reported negotiating terms for carrying the overseas air mail. The new Zeppelin is expected to be able to fly mail to Europe in forty-eight hours. Lest the United States lag in developing its own ocean airways, a program for the construction of two giant airships for commercial transatlantic service is being urged upon the government by the National Advisory Committee for Aeronautics.



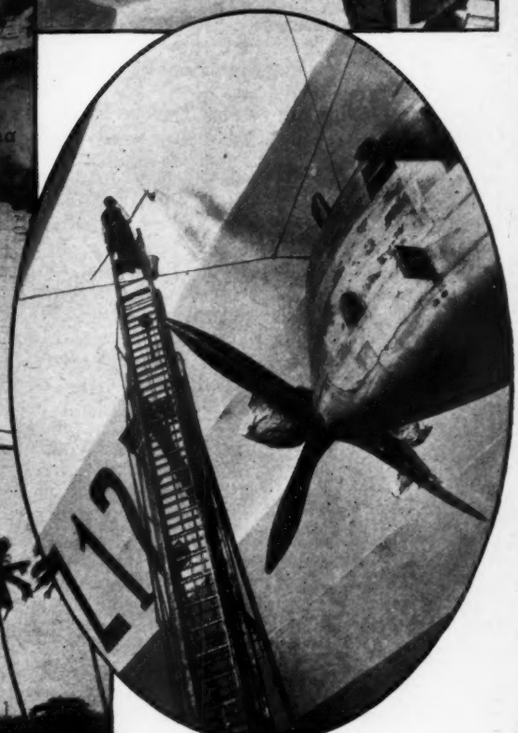
Uniformed men from the Friedrichshafen naval school keep sightseers out of the way as the *Graf Zeppelin* ground crew prepares to walk the airship out of its hangar at start of flight

Below, one of the letter boxes into which mail, to be carried to South America by the *Graf Zeppelin*, is dropped. This box is near the airport and is for the late mail only

Above, unusual photograph of an Atlantic liner taken from the deck of the *Graf Zeppelin* as the airship flew across the Atlantic. At right, dining on board the *Graf Zeppelin*. Six meals are served each day to the passengers during the trip. Below, officer tracing progress of flight on map for passengers



Above, control room of the *Graf Zeppelin*, showing the helmsman's station and some of the dials that tell the commander how the ship is sailing



Above, workman giving *Graf Zeppelin* a fresh coat of paint. This is done before each trip as an aid in controlling the temperature of gas in the envelope

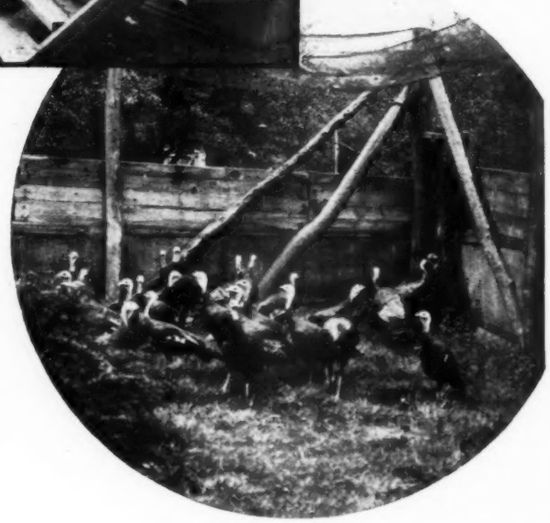
Left, western end of the transatlantic flight. The *Graf Zeppelin* is shown at its mooring mast at Pernambuco, Brazil

Wild Turkey Paradise

Saves Our Famous Bird

By ROBERT E. MARTIN

On the wild turkey preserve in Maryland the hunter is permitted to kill only four birds a year. Photo shows sportsman who has bagged his four turkeys



Left, brooder houses for pheasants on the Woodmont, Md., bird haven. Each house accommodates 250 pheasants. Below, the brood flock of 200 hens and 30 gobblers

IN THE wooded hills along the Potomac River in western Maryland, the wild turkey, with the aid of one courageous sportsman, is making a last determined stand against extinction. The turkey, like the bison, was slaughtered ruthlessly by early hunters and has disappeared entirely from many areas. But, because of the vision of one man, extinction is no longer a serious threat.

Safeguarded on a 6,000-acre tract of woods and rolling fields, the turkeys have multiplied rapidly. Each year hunters, privileged to shoot over the preserve, bag 1,000 of them. An additional 2,500 are shipped all over the country, and even abroad, to propagate their kind. Yet, despite these inroads, there are today 25,000 wild turkeys on the preserve.

Creation of this singular haven has been the work of thirty-five years. Since 1899, Henry P. Bridges, the sportsman who conceived the project, has devoted his life to the work. Others, before Bridges, had tried to raise wild turkeys in captivity and had failed. The natural temper of the turkey, the depredations of rodents, and the ravages of disease made the attempt a source of constant disappointment.

BRIDGES had been a hunter and nature lover since boyhood. It disturbed him to find that wild turkeys had been practically annihilated in Maryland. The time was not long past when hunters in that state, in Virginia, and the Carolinas had slaughtered them by the thousands. Slaughtered is the right word, for the hunters first trapped the birds and then shot them from blinds. It was a regrettable state of affairs and, old hunters told Bridges, nothing could be done about it. But Bridges, despite the head-wagging, decided that something could be done.

Bridges, a retired lawyer, had the leisure to carry out his undertaking. Morning after morning, he would get up before dawn and take to the woods to study the habits of the few surviving turkeys. Screened by heavy cover, he would summon the birds with a turkey call and study their mating, laying, and nesting habits and the food they ate. He soon saw the error of trying to raise wild turkeys by the methods of the common poultry yard.

He found, for example, that a diet of grain would never do. The wild turkeys demanded a generous supply of spiders, grasshoppers, crickets, snails, beetles, and caterpillars. The U. S. Biological Survey corroborated his findings. Gizzards of wild turkeys showed that their diet consisted of fifteen and five-tenths percent animal matter and eighty-four and five-tenths percent vegetable.

When he believed he had thoroughly mastered his problem, Bridges, with a homemade trap of chicken wire, took two gobblers and two hens. Choosing a large farm near Hancock, Md., he began his breeding experiments. He was striking out into an entirely new field with no experience to draw upon except his own studies in the woods and no rules to guide him except his own common sense. By the painful and sometimes discouraging method of trial and error, he evolved his own system of hatching and brooding and developed his own feeds and his own means of keeping the turkey houses and ranges sanitary.

The flock increased, for Bridges, gaining experience, found that raising the younglings was not an insuperable problem. By selective breeding, he improved the quality of his stock and before long he was in position to send young turkeys to private and public game preserves.

Once he had demonstrated the practicability of breeding the wild fowl domestically, he found that sportsmen every-

Henry P. Bridges, savior of the wild turkey, is shown inspecting a few of the thousands of wild turkeys he has successfully bred in captivity

where enthusiastically supported the work. Conservation societies, hunting clubs, and private land owners snapped up the young turkeys as fast as Bridges offered them. The farm at Hancock became famous wherever wild turkeys were known.

It was then that the Woodmont Rod and Gun Club asked Bridges to move his breeding stock and equipment to the club's preserve. Bridges had been a member of the club for years and was active in its affairs. Sensing an opportunity to broaden the scope of his work, he accepted the invitation.

The Woodmont preserve was one of the finest in the country. It embraced 6,000 acres of some of the most picturesque country in the east. The club had been founded in 1870 by Rear-Admiral Robley D. (Fighting Bob) Evans. Sometime earlier Evans had accepted the invitation of a Maryland mountaineer to hunt over the hills along the Potomac. The mountaineer showed Evans a wooded plateau between Sideling Hill Mountain and Ronoloway Ridge that was as near to being a hunter's paradise as Evans ever hoped to see.

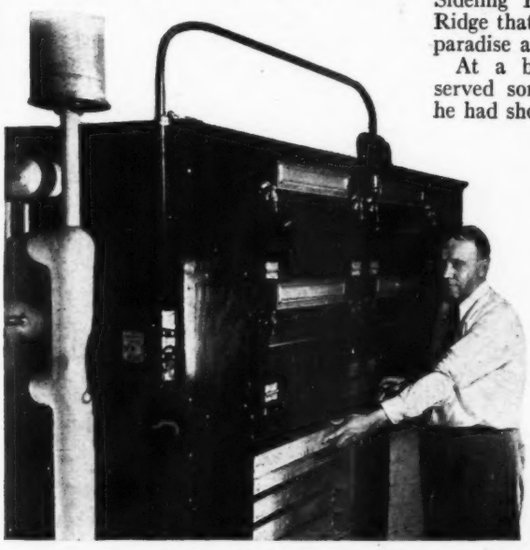
At a banquet in Washington, Evans served some of the turkey and venison he had shot and the banqueters went wild over it. Evans fanned their enthusiasm with glowing tales of his experiences. As a result of this propaganda work the Woodmont club was formed. On its roster were cabinet members, congressmen, capitalists, business men, and Army and Navy officers. The tract on the Potomac was bought. For years the only club house was a log cabin that had been used by Washington while on his survey for Governor Fairfax of Virginia.

The club was destined to become one of the wealthiest in existence. Its sixty members, before the depression, were reputed to be worth $800,000,000. Five presidents have tramped through its forests and President Roosevelt was to have spent a few days there last fall. Its present clubhouse, modestly called a lodge, is a veritable palace.

No such luxury marked the club when Bridges moved his wild turkey flock over from Hancock. The log-cabin clubhouse had recently been burned and a reorganization of the membership was to be attempted. Plans were made for a new clubhouse and the preserve was enclosed. Fourteen miles of fence were built, an undertaking that took twenty-five carloads of wire and 4,000 locust posts. The fence was nine feet above ground and extended eighteen inches into the ground to bar the entrance of burrowing rodents.

For the first several years, hunting turkeys on the preserve was forbidden, and the ban was not lifted until the birds in the flock numbered 400. Then the original flock was freed and hunters for the first time were permitted to shoot them. But several stringent restrictions were imposed. The bag was limited to two turkeys on any one day and to four birds for the season. It was further stipulated that hunters using pump guns should carry not more than two shells in the chambers of their guns. This restriction placed them on an equal footing with the men hunting with double-barreled shotguns.

The liberated birds at first found their freedom a temptation to desert the preserve. They spread rapidly over the countryside but soon discovered the error of their ways. The neighboring woods offered no such luxurious *(Continued on page 109)*

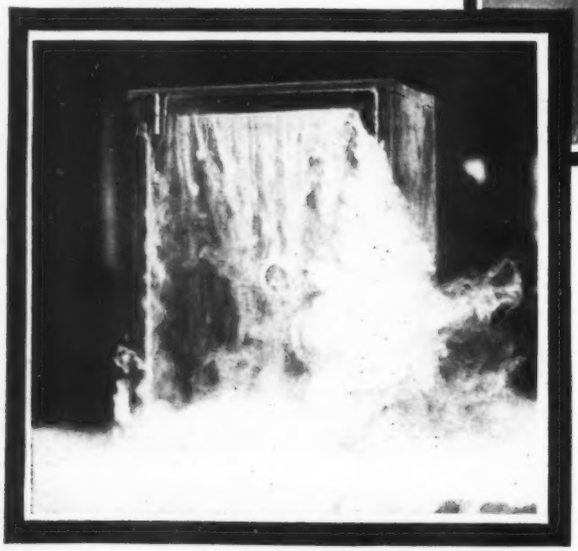


In this electrically heated incubator, pheasant and quail eggs are hatched at Woodmont. Its capacity is 10,000 eggs

Powerful Gas Weapons

Police Bureaus Methods of Chemical Warfare to Bring Peace to the Streets of Desperate Cities Are Also Used Against Mobs and Criminal Gangs

Above, chemical grenades and candles of various types. At the front is a fragmentation grenade included for comparison. The smaller grenade shown in the center is designed to be carried conveniently in the pocket by policemen. At left, an officer armed with a gas riot pistol is advancing behind a bullet-proof shield of the type now used by policemen



Above, a new police weapon that combines the traditional billy with a tear-gas gun. Left, tear gas, released by an automatic device, pours from a safe and flows onto the floor around it to foil burglars: The heat of an acetylene torch, or tampering with the lock of the safe, releases a stream of gas. Many banks and postoffices now use this device

PERHAPS you read, not long ago, about the spectacular ending of the careers of two notorious criminals, Harry and Jennings Young. Wanted for a number of murders and other crimes, the two men were trapped in a house at Houston, Texas. Police officers, surrounding the house, threw several tear-gas grenades into the building. A few minutes later they entered, and a search revealed that the desperadoes had barricaded themselves in the bathroom. When an attempt was made to force the door, the trapped men opened fire.

"We're dead. Come and get us," one of them called out. At the same instant, officers shot tear gas through the bathroom window. Almost immediately the sound of pistol shots came from within the room. After the gas had been given time to act, police opened the bathroom door and found one of the men dead and the other dying. Rather than surrender to the overpowering gas and the law, the criminals had shot each other.

Contrast this with a scene that had taken place a short time before in Missouri. There the Young brothers had barricaded themselves in a farmhouse. A group of officers, armed with the usual pistols and with a small quantity of tear gas, surrounded the house. Because of an insufficient amount and improper use, the gas contributed nothing towards subduing the criminals. In the fighting that followed, six officers were killed and several wounded. While reinforcements were being obtained, the two desperadoes escaped.

This bit of recent history serves to illustrate the effective way in which chemical warfare can be used against armed criminals. But tear gas and other chemical substances are not used merely in the war against gangsters. They are employed in the bloodless subduing of mobs, protection of valuable property locked in safes, repulsing of vicious dogs, and safeguarding of the home.

Such gases supply peace officers with a humane method of making people behave. They cause no permanent injury and reduce the necessity for the use of firearms with consequent danger to innocent bystanders, including women, and children. Even bullets often fail to halt a highly enraged mob; but there is no record of a rioting crowd that failed to heed the relentless effect of an adequate quantity of tear gas or one of its more powerful brothers.

The use of the so-called non-lethal or non-killing gases is a phase of chemical warfare that developed directly from the World War. Although chemical warfare, as applied to peace-time control of crime and protection of property, is new to most persons, the idea of using chemicals as weapons is an old one. At different times for more than 2,000 years,

Aid War on Gangsters

By
WALTER E. BURTON

Oriental peoples have employed various chemicals in fighting. The finely ground pepper of the Japanese and the stinkpots of the Chinese are the ancestors of the modern gas grenades and guns. Various armies have used sulphur, Greek fire, and similar means of chemically attacking or repulsing their enemies. During our own Civil War, sulphur fumes were used for a gas attack in the siege of Charleston, and shells containing Greek fire were dropped on the city.

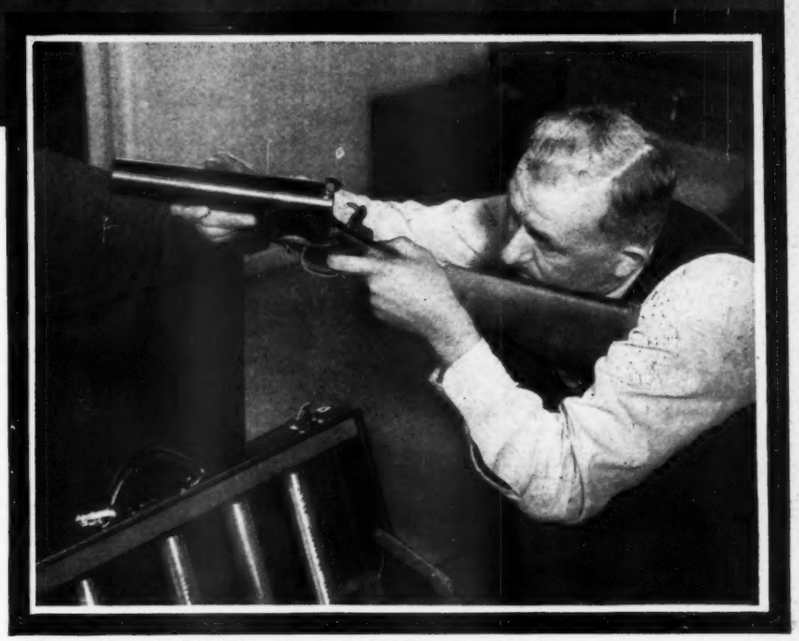
In the afternoon of April 22, 1915, British and French soldiers saw a heavy, greenish cloud rolling ominously towards them. It was chlorine gas, released by the German army. Thus was poison gas, regarded by many military experts, who point to comparative figures between gunshot and gas casualties, as the most humane weapon ever developed, added to the world's armament.

About 1919, army chemical officers began to consider some of the non-poisonous wartime gases as possible weapons for use by law-enforcing officers in time of peace. As a result, the modern non-lethal gases, which have come to be associated with riots and other violence, have been given a prominent place in police equipment.

Chemical agents suitable for law enforcement can be divided into three groups. The mildest agent is Hexachlorethane or "HC," a few ounces of which, mixed with certain inorganic compounds, will produce more smoke than a million pipes of peace. HC mixture generally is employed in hand grenades, rifle grenades, and candles. The dense smoke, which blots out everything that it surrounds, has a sweetish smell, is harmless to the person encountering it, and does not make the use of a gas mask necessary. The laying of smoke screens is becoming recognized as a valuable tactical operation by police and military organizations. Behind a smoke screen, for instance, officers can approach a house containing barricaded criminals, and then can pour bullets or gas into the building. Any shots directed towards the officers will be random and hence seldom effective, as the criminals cannot see their targets.

Tear gases, or lachrymators, are, as their name indicates, intended to induce violent weeping. The abundant flow of tears causes temporary blindness; and such blindness interferes considerably with whatever it was the victim intended to do. Some tear gases are capable of producing blinding tears when they are present in only one part of gas to 10,000,000 of air.

Chloroacetophenone, or CN, a white, crystalline solid similar to granulated sugar in appearance, is the chemical usually employed in tear-gas grenades, candles, and guns. In addition to inducing violent weeping, it is, in



Gas can be used effectively at long ranges. Here an officer is firing with a gas "field gun" at a building across the street

Soldiers advancing against rioters behind a barrage of tear gas, which is now considered the most humane way to quell disorders. At right, a small tear-gas projector that can be carried in the pocket and is loaded as shown

Using a twenty-gauge shell, this tear-gas projector has a safety ring to bar mishaps

An aerial bomb for scattering tear gas. This might be used effectively in civil disorders

concentrated amounts, painful to the skin. Discovered in 1877, this compound was not developed into a practical tear gas in time for use in the World War. It is a remarkably stable substance. It is capable of withstanding high temperature, does not corrode metal shells or grenades containing it, and is not affected by moisture. In its work of producing tears, it acts as a finely divided solid, like so much super-pepper. It is distributed by means of shells containing small amounts of explosive, or by means of candles or burning-type grenades. Solid CN particles have the pleasant odor of locust blossoms. This tear gas produces violent weeping and skin itching. Fair protection against it can be provided by tight-fitting goggles and cellulose pads held over the nose and mouth.

When CN is dissolved in chloroform, benzene, chloropicrin or other solvent, it becomes a more powerful producer of tears. CNS, as this form is called, no longer smells like a locust tree in bloom, but instead produces a violent, biting sensation in the nostrils. Besides producing tears in overwhelming quantities, it causes severe irritation of the nose, throat, and skin. The best gas mask is necessary for complete protection. Shells, and hand and rifle grenades of the explosive type, are used to disperse CNS.

IF TEAR gas, or CN solution, fails to stop the mob, or if the person being dealt with is a dangerous criminal, there remains still a more severe chemical that the modern law-enforcement officer can use. This is an irritant smoke. The substance most commonly used boasts the name of Diphenylaminechlorarsine. To save breath, chemists have abbreviated this to DM or KO. In pure form it is bright yellow, and in the crude form, green.

Like Chloracetophenone, this compound was not developed in time for use in the World War, although the Germans knew how to make it in 1913. In solid form, it has almost no odor; but when distributed through the air in the form of finely divided particles or smoke, it smells like smoke. The victim has little time to appreciate this odor, however, for the compound causes a violent burning of the throat and nose, followed by sneezing, coughing, vomiting, and prostration. A splitting headache lasting for several hours may develop. The effects of KO gas usually last for half a day, whereas the effects of ordinary tear gas may last for only a short time. Irritant smoke is dispersed by means of candles, which are thrown like hand grenades. The best commercial gas mask, equipped with a mechanical filter, is needed to provide protection. Even then, the gas may cause a skin rash when present in high concentration.

PARTICULARLY effective are the gases that are a combination of tear gas and irritant smoke. No one who lacks a suitable gas mask can withstand such a combination. Yet in a comparatively short time, the person unlucky enough to come in contact with the gases will recover.

A considerable array of weapons has been developed for use of tear gas and similar non-lethal chemicals. Perhaps the most-used gadget for dispersing tear or similar gas where it is wanted is the chemical grenade. This consists of a metal container filled with the material, accompanied by an explosive charge which is set off by a firing mechanism, or a material that burns and releases the gas. As long as the grenade is not in use, a safety pin prevents the firing mechanism from operating. Just before the grenade is hurled, this pin is pulled out. A spring then throws the lever off and causes a firing pin to strike the primer, igniting a fuse, which burns for a brief interval before the main charge is fired.

Explosive grenades usually contain CN dissolved in a liquid which causes irritation to the throat and nose, so that, together with the action of the tear gas on the eyes, a three-point attack results. Such gas grenades are effective instantaneously.

Burning grenades require several seconds or minutes to deliver their load of gas. Smokeless powder mixed with CN produces one form, the powder acting as fuel. Another combination is CN with the HC smoke mixture, which acts as a screen as well as a tear-producer. A third form of burning grenade is filled with the harmless HC smoke mixture, and is used solely for screening purposes.

A close relative to the gas grenade is the chemical candle. The candle now in general use was developed not long ago by the Chemical Warfare Service. It consists of a cylindrical metal container measuring five and three quarters by two and three eighths inches and equipped with vent holes that are opened by the action of the burning material inside. This fuel is mixed with tear-gas material. A standard candle burns about three minutes, while a quick-burning type discharges its gas in less than thirty seconds. Either tear gas, irritant smoke, or a screening smoke can be used in such candles. Candles contain up to five times as much gas-producing material as hand grenades. Unlike some grenades, the quick-burning candles cannot be picked up and thrown back at the original thrower. This is because there issue, through numerous holes in the top and along sides of the steel container, blasts of gases that make it impossible for anyone to pick up the candle.

VARIOUS types of guns have been developed for discharging tear gas. In fact an ordinary pistol, rifle, or shotgun of .38 calibre or larger can be employed to fire tear-gas shells. A shell smaller than .38 calibre cannot hold enough tear gas to be effective.

The Big Bertha of gas artillery is a so-called field gun that fires gas projectiles over ranges up to 450 feet. It is intended for use against criminals barricaded in a building, and under similar circumstances. The shell is one and one-half inches in diameter and ten inches long. The firing charge ignites a fuse in the projectile, which in turn causes an explosive charge to scatter the gas material at the instant the shell arrives at its mark. Short-range shells, for use over distances up to thirty-five feet, and long range shells, for use up to 450 feet, are provided. The gun also can fire star shells, equipped with tiny parachutes, which illuminate the landscape at night, or *(Continued on page 104)*

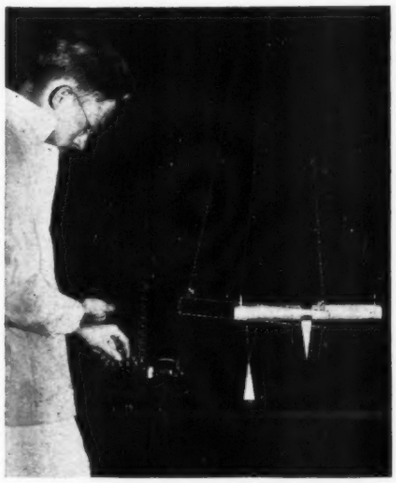
Above, the business end of a gas gun that shoots either short- or long-range shells. At right, a portable tear-gas arsenal used by officers in long-range attacks against barricaded criminals, or in defensive fighting at close quarters

Mysterious New Aircraft Powered by Reaction Motor

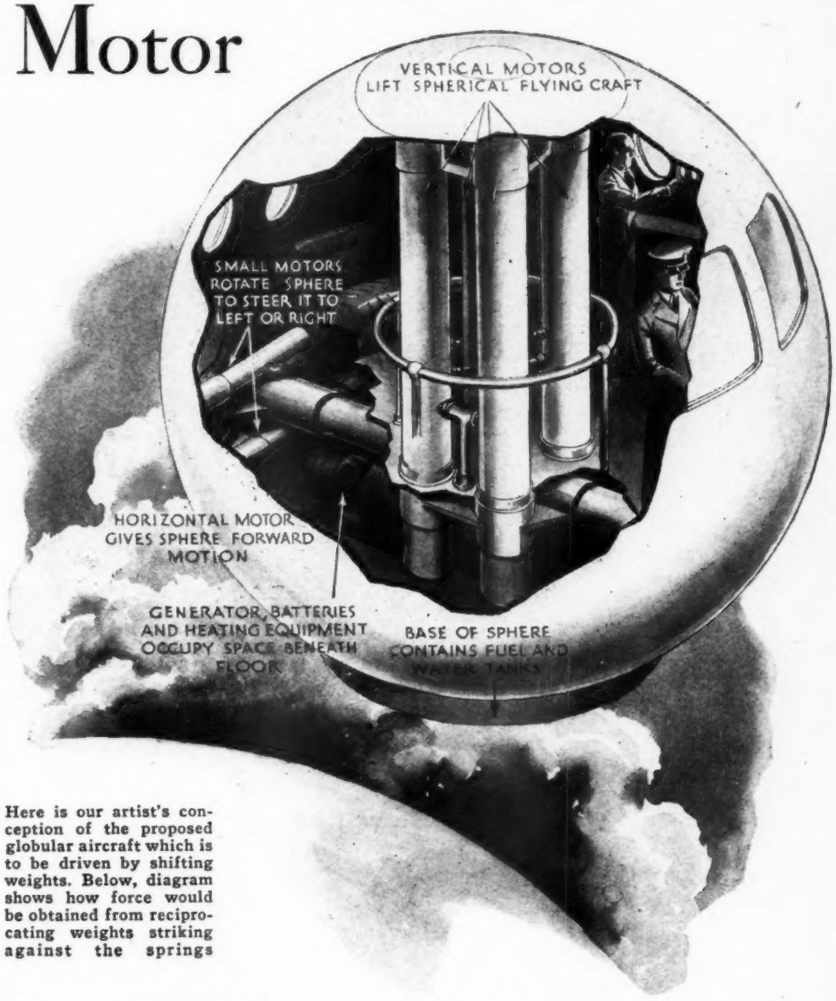
IMAGINE a heavier-than-air flying craft devoid of any visible means of propulsion, which rises from the earth and travels through the air in apparent defiance of the law of gravity. Lifting itself by its own bootstraps, by slinging weights about its interior, it could navigate at will in the stratosphere or even in the unknown reaches of outer space. Such a craft is brought within the realm of speculation by pioneer experiments of Harry W. Bull, of Syracuse, N. Y., with an entirely new form of propulsion that he terms the reaction motor.

Suspended from a pair of light, flexible wires, in his laboratory, hangs a cylindrical tube about a foot long. At the touch of an electric switch, it becomes alive and leaps forward, as if drawn by some invisible magnet. Actually the power plant, a simple system of reciprocating weights, is contained within the tube itself.

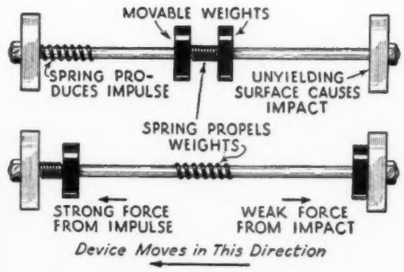
This elementary form of reaction motor operates on a principle that has long been neglected by engineers, but which Bull believes can be applied in aircraft and other vehicles. It depends upon the difference in effectiveness of two ways of transmitting energy, which can be termed impact and impulse. If a weight is thrown against a solid wall, it is stopped by impact, and much of its energy is wasted in distorting the weight and wall and in producing heat. However, if the weight is thrown against a spring fastened to the wall, it is stopped by impulse, the spring conserving the energy of the moving weight and transmitting the resulting force, with little loss, to the wall. Tests have shown a weight will yield three times more force by impulse than by impact.



Harry W. Bull, Syracuse, N. Y., inventor, exhibits an experimental model of his reaction motor with which he hopes to power an aircraft that will, apparently, defy gravity. When the power is shut off the two pointers, above, coincide. Weights in the device are operated by electromagnets


VERTICAL MOTORS LIFT SPHERICAL FLYING CRAFT
SMALL MOTORS ROTATE SPHERE TO STEER IT TO LEFT OR RIGHT
HORIZONTAL MOTOR GIVES SPHERE FORWARD MOTION
GENERATOR, BATTERIES AND HEATING EQUIPMENT OCCUPY SPACE BENEATH FLOOR
BASE OF SPHERE CONTAINS FUEL AND WATER TANKS

Here is our artist's conception of the proposed globular aircraft which is to be driven by shifting weights. Below, diagram shows how force would be obtained from reciprocating weights striking against the springs



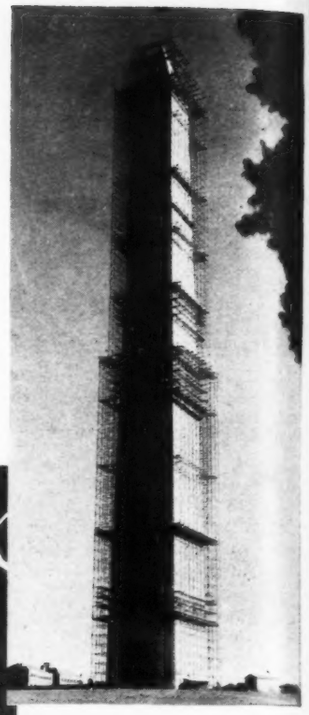
Applying this principle in the manner shown in the accompanying diagram, he mounts two movable weights in a cylinder and starts them simultaneously in opposite directions. One is stopped by a flat steel plate, and the other by a spring. The difference in the effectiveness of the two blows, as explained above, is sufficient to kick the cylinder forcibly in the direction of the spring. The weights may be returned to their original positions by any standard mechanical means, and the cycle repeated continuously, providing a steady and self-contained driving force without recourse to propellers, rocket jets, or any other familiar means of propulsion.

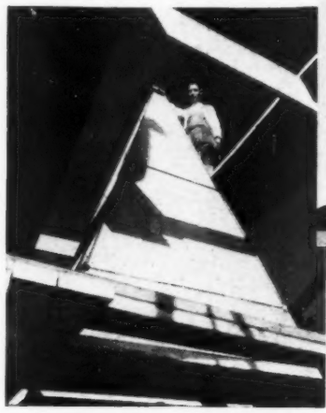
From the present experimental model to a reaction motor powerful enough to lift aircraft seems a long step. Achieving a practical reaction motor, Bull points out, depends to a large extent, paradoxically, upon how inefficient it can be made. The more force that can be wasted in impact, the greater force will be left to push ahead, a new problem for engineers, who have spent years trying to conserve energy rather than dissipate it. Likewise, much experimentation remains to be done upon the impulse side of the apparatus, which is still far from efficient.

Supposing these difficulties overcome, what would an airship, driven by a reaction motor, look like? Bull visualizes a globular craft with a motor in the form of an upright cylinder containing two pistons operating in opposite directions, one delivering an impulse and the other an impact. A carburetor adapted for mixing vaporized oxygen and gasoline would supply an explosive mixture to drive the pistons. Several cylinder units could be used to obtain a steady lifting force. Others placed horizontally would provide forward motion. A similar impulse-impact cylinder of reduced size, operated electrically and mounted near the outer shell of the ship, would rotate the craft for steering. An airship driven by this new method could travel at high speed and could be used at either high or low altitudes.

USE HIGHEST SCAFFOLD TO CLEAN MONUMENT

So WORKMEN may give the Washington Monument, at Washington, D. C., its first cleaning and overhaul since it was completed fifty years ago, the 555-foot shaft has been encased in the highest continuous scaffold ever built. Standing on planks laid across the steel framework of the giant scaffold, workmen will cut away all weakened mortar. The joints thus dug out will then be filled with fresh mortar and the Monument will then look like new.





Above, Washington Monument photographed with scaffold built up around it from bottom to top. At left, workman sitting on plank at the very tip of the Monument, 555 feet high

NEW FAD IN SPORT BASED ON ANCIENT INDIAN GAME

At top, throwing an arrow with Mayan hul-che stick. Inset, a close-up of stick

THROWING arrows with the hul-che, a weapon used by ancient Mayan hunters, has been revived in Los Angeles, Calif., as a new sport. Discovered by a noted archeologist in Mayan ruins, the hul-che is a short stick with a hook at one end and a grip, with two finger holes, at the other. In position for discharging an arrow, the hooked end rests against the feathered end of the arrow, the shaft of which lies across the fingers of the thrower's hand. The stick is, in effect, an extension of the human arm.

BULL BAILS OUT IN PARACHUTE

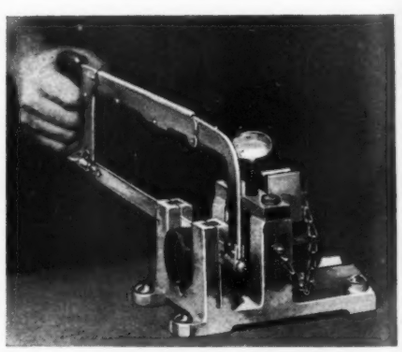
RUNNING out of dummies in their tests of a new type of parachute recently, Italian aviators pressed a bull into service. With the parachute tied around him he was dumped out of a bomber at a height of several thousand feet. When he touched the ground he took off across the fields in terror.

HOTEL LIGHT SIGNALS ARRIVAL OF MAIL

EACH guest in a large Chicago hotel is notified instantly of the arrival of mail by a sorting rack that automatically causes a green light to flash on in his room. Each of the cubbyholes in the rack contains a metal flap that hangs vertically when the hole is empty. When a letter is inserted, this flap is pushed up, completing an electrical circuit and switching on the light in the room of the guest to whom the mail is addressed. By pushing a button, the guest may notify the bell captain that he wishes the mail delivered by bellboy in his room.

Above, light that automatically goes on in room of hotel guest when there is mail for him. Right, rack that gives signal of mail

Below, panel over hotel bell captain's desk that shows light when a guest wants his mail



TUBING CUT OFF SQUARE WITH NEW TYPE VISE

CUTTING perfectly square ends on thin copper or brass tubing, without crushing or marring, is made easy by a vise recently placed on the market. All sizes of tubing from one eighth of an inch to two inches are quickly locked in place by means of a reversible vise block and thumbscrew. A saw guide keeps the blade running in a straight line, assuring an accurate right-angle cut without chipping or distorting the end. The vise is made of aluminum with steel inserts to increase its strength and insure the durability of the tool.

Handy Man

By
BERTON BRALEY

•

IN AN AGE of Specialization
When each of us labors at
A *part* of an operation
And doesn't know more than that;
When everyone's concentrating
As narrowly as he can,
I choose to be celebrating
The General Handy Man!

Who can paint and plumb
By the rule of thumb;
Mend a roof with tar
And tinker a car;
Mix concrete,
Build a garden seat
Or solder a leaky can;
The highly efficient
Nearly omniscient
General Handy Man!

When a Doctor's life-long mission
Is Noses—and nothing else!
When a Scientist's whole ambition
Is to study the tails of smelts!
When each of us seems to yearn to
Be a cog in the Cosmic Plan,
It's rather a joy to turn to
The General Handy Man!

Who can paper a room,
Make a garden bloom,
Mend a screen
Or a mowing machine;
Make a radio talk
When it seems to balk,
Make a battery work
When it tries to shirk,
Fix a chimney flaw
So the flue will draw—
Oh it's quite a relief to scan
This skilful jack
Who will take a crack
At *any* job, with the
versatile knack
Of the General Handy Man,
The smart and sensible
Indispensable
General Handy Man!

MAN-MADE WINTER TESTS INSULATING MATERIAL

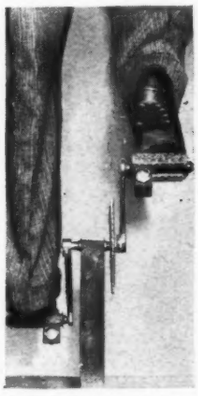
TO TEST the ability of his product to withstand rigorous temperatures, a manufacturer of building insulation produces his own winter in his own laboratory. The weather-making room is a simple cell in which artificial refrigeration creates winter temperatures down to five degrees above zero. One wall of the room is pierced by a three-foot square opening. This opening, when a test is under way, is covered in turn by standard building materials such as brick and wood and special insulation materials. Electrical devices attached to the outside of the wall show the amount of heat escaping.

FIREMEN START BLAZE

NEW YORK CITY fire-fighters set fire to a tenement building recently to get it out of the way of a tunnel. This gave them a chance to test a sprinkler system and several types of fire-retarding walls. Three engine companies were ready to check the flames had they spread too far.

LIGHTS ON BICYCLE PEDALS

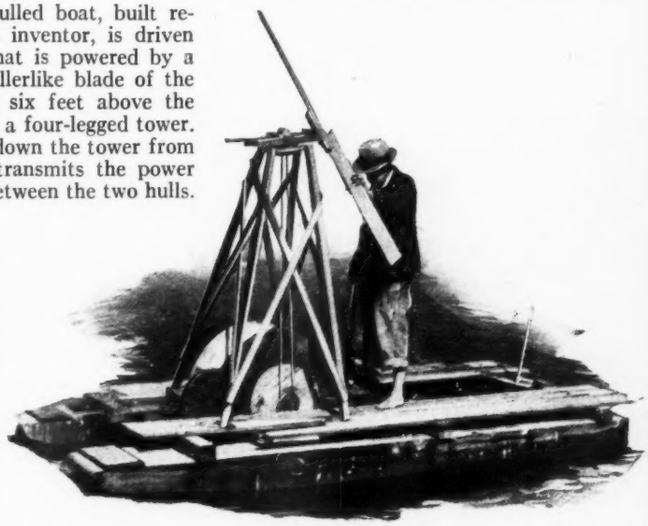
TRYING to reduce the dangers of night cycling, an English inventor has developed a pair of moving tail lights to render cyclists more readily visible to motorists coming up behind them. The lights consist of red reflecting lenses fixed in short blocks, one of which is bolted to the underside of each pedal of the bicycle. The lenses are thus kept in motion by the pedaling of the cyclist, remaining stationary only so long as he is coasting. They arrest a motorist's attention quickly, and tell him that it is a bicycle he is overtaking.



Reflectors on bicycle pedals warn motorists

WINDMILL ON DECK RUNS STRANGE BOAT

A STRANGE, twin-hulled boat, built recently by an Oregon inventor, is driven by a paddle wheel that is powered by a windmill. The propellerlike blade of the windmill is mounted six feet above the decks of the craft, on a four-legged tower. A rope belt, running down the tower from the propeller shaft, transmits the power to the paddle wheel between the two hulls. With the pulleys geared down, the boat can be propelled at fair speed in even a light breeze. The unusual craft is steered by a rudder attached to the planking that connects the twin hulls at the stern. The tiller, rising about three feet above the decks, can be operated by a standing man.



The paddle wheel of this unusual boat is run by the windmill seen on deck

FINGER PRINTS SOLVE ANCIENT RIDDLE

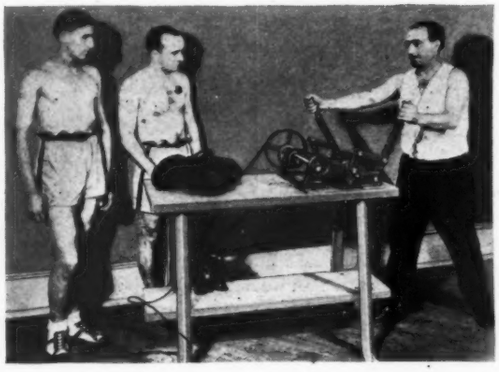
Left, natives excavating a mound at Tell en-Nasbeh, Palestine, believed to be the site of the city of Mizpah named in the Bible

Below, a finger print made 3,000 years ago by a Palestinian potter and used as evidence by the archaeologists to fix the age of ruins

FINGER prints made 3,000 years ago are being used to determine the age of pottery recovered from what are thought to be the ruins of the Biblical city of Mizpah in Palestine. Archaeologists usually assume that an article recovered at a lower level than another belongs to an earlier period. The finger prints, pressed into earthen jars by ancient potters, have shown that in the case of this particular ruin, the same worker fashioned objects found at various levels.

ROBOT EXERCISES ARMS OF BOXERS

A MECHANICAL training device that teaches a boxer to move his arms straight and fast has been invented by a Pennsylvania shoemaker. Two handles, powered by an electric motor, fly back and forth at terrific speed while the boxer hangs on to them. According to the inventor, this develops the boxing muscles. In the photograph at the right, he is demonstrating his machine.



SLOT MACHINE VENDS CONCENTRATED SUNSHINE

FOR those who cannot afford a trip to sunnier climes, an automatic vending machine provides what is said to be the equivalent of a day's exposure to sunshine at the beach. Dropping a coin in a slot turns on an artificial sun-tan lamp, before which the customer may bask for seven minutes before the lamp automatically shuts itself off. As a precaution against an overdose, a printed notice on the machine warns the user against another treatment inside of three days.

WATERS POTTED PLANTS WITH SANDSTONE WICK

A STONE wick that waters potted plants has been tested with success by Prof. B. E. Livingston of Johns Hopkins University, Baltimore, Md. The rod, made of fine-grained artificial filtering material resembling porous sandstone, is placed in the pot with one end extending down through the hole in the bottom into a pan of water. This wick carries up just enough water to keep the plant healthy.

DAIRY EXPERT HAS FURNITURE HOBBY

THE problems of dairy farming which engross K. E. Parks during the hours he spends in the Bureau of Dairy Industry at Washington are displaced from his mind during leisure hours by problems such as that of turning a leg for a piece of period furniture. Parks is only now getting into his full stride as a creator of fine furniture and ship models. Heretofore, much of his time has been occupied with equipping the shop beneath the porch of his home. The jig and circular saws, the bench lathe, the drill press and other pieces of equipment were not only designed by Parks but built by him. A single item, a drill press, saved him $300, the amount it would have cost if purchased commercially. A drawing board is conspicuous among the equipment. It is upon this that the details of everything he builds is first set down by this methodical hobbyist. His plans for the future include the building of unusual furniture.

K. E. Parks at the back-geared engine lathe he designed and built himself

New Suit Aids Divers' Quest for Gold

INDEPENDENT of air supply from the surface, a grotesque diving suit recently perfected, is expected to carry a marine salvager down 2,500 feet, a depth hitherto impossible for divers. The body of the suit, enclosing the head as well as body, consists of two massive steel sections joined at the waist. Heavily reinforced rubber tubing is used for the arms and legs. Tools, such as claws, hooks and hammers, are attached directly to the ends of the arms and are operated by hand screws inside the sleeves. Powerful lights, bolted to the crown of the suit and to either arm, furnish illumination for work on the bottom. The suit contains a telephone for instant communication with the surface. While on the bottom, the diver exhales through a mask connected with a can of caustic soda and charcoal which absorbs the carbon dioxide in his breath. A flask within the suit meanwhile liberates oxygen so that the atmosphere remains of normal composition and pressure. Through these means the diver can work below water for four hours at a time without experiencing ill effects. As a result the diver can be raised to the surface without the delay necessary to prevent "bends," an affliction common with suits now in use.

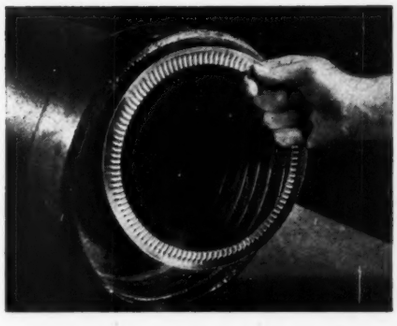
Right, new diving suit in which worker may reach 2,500-foot sea depth. Left, diver in new suit ready to be lowered into East River, New York City, in test of its operation. Below, diver in lower part of suit and wearing the mask through which he breathes during his submergence

ELECTRIC MOTOR POWERED BY SUNLIGHT

These plates are used to turn sunlight into electricity to run motor

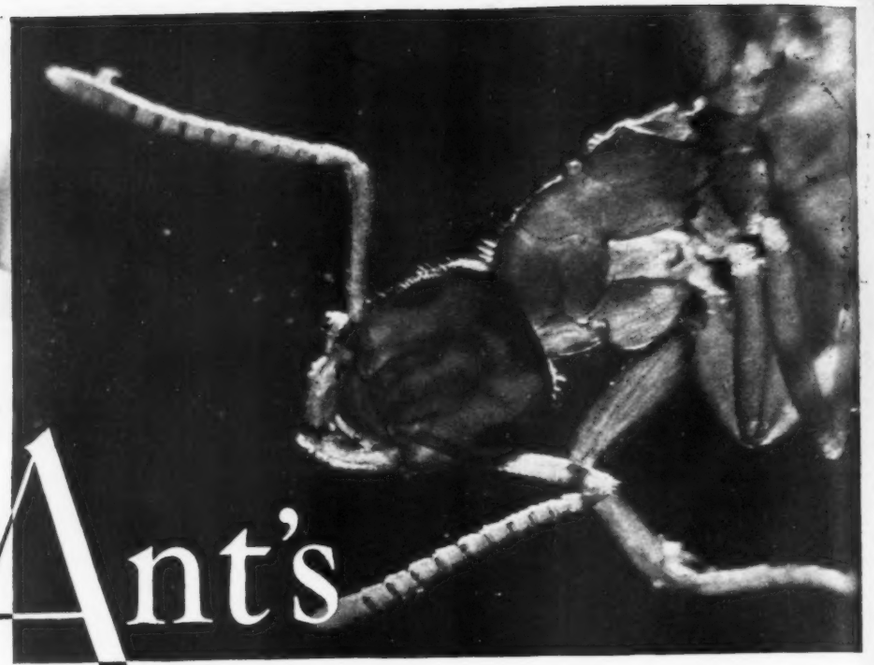
WHAT is said to be the first sun-powered electric motor constructed in this country has been completed by J. Thomas Rhamstine, Detroit inventor. When sunlight falls upon a set of light-sensitive plates, shown at the center of the accompanying picture, it is transformed into electricity. A current flows between the front of the photo-electric plates, which is positively charged, and the metal back which is the negative pole. This current spins an armature.

COPPER RINGS PROTECT SEWER PIPE FROM ROOTS



TO PREVENT roots from entering a sewer pipe and clogging it, protective rings have been placed on the market for insertion in each joint between sections of pipe, as shown above. Made of copper, the rings are declared to last indefinitely. When hairlike root tentacles penetrate a leaking joint and encounter the ring, they are chemically poisoned and their growth in that direction is stopped, although no harm whatever, it is said, is done to the tree or plant to which they belong. The pipe, also escapes all injury.

Ants for microscopic study are killed by dropping them in carbolic acid. At right, magnified head of ant showing strong jaws



Ant's Strange Equipment

SEEN IN YOUR MICROSCOPE

Foreleg of ant enlarged about 200 diameters. Note the comb with which the insect cleans its body. One part of the comb folds like a knife blade against the leg when not in use

NO MATTER where you go, you cannot escape the busy ant, except on the tops of the highest mountains and in extreme polar regions. You can find ants in the dry, hot desert or the steaming tropics. If you are like most persons, you have little love for them. Rather you notice them because of mingled feelings of curiosity and fear. They seem, as you watch them going about their busy ways, to be guided by a mysterious sort of intelligence and to possess a power that is a bit threatening to your personal comfort.

If you are a microscope hobbyist, the ant will appeal to you in another way. "Surely," you will tell yourself, "such an insect ought to have a few secret wonders that my magic lenses will reveal."

Put one of these creatures on a slide and look at it at even a low magnification of twenty diameters or so, and you will marvel at some of these wonders. An easy way to capture ant specimens is to hold the bowl of a teaspoon where one of them will crawl into it, moving the spoon about until the insect, which at first will attempt to run around it, decides to try a short-cut. Lift the ant and deposit it in a wide mouth bottle by tapping the spoon on the bottle edge. In the bottle can be denatured alcohol or a strong solution of carbolic acid. The latter, which must be kept off skin and clothing, is preferred by some microscopists for killing insects because it renders them somewhat more transparent. Before dissecting or mounting a specimen killed in the acid, wash it well in clear water.

You will find that black ants do not make as good microscope specimens as those of lighter color, such as red, because they are opaque to light. Small red ants that you can capture in any garden are sufficiently translucent to make beautiful objects when placed whole on the slide, either dry or in water, liquid petrolatum, or other medium.

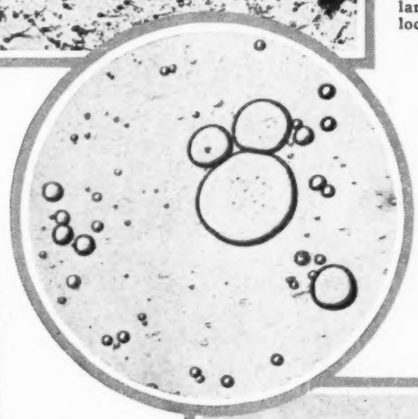
Ants are outstanding social insects. The colonies are composed of different types of individuals, like colonies of bees and certain wasps. These form the highly specialized castes including workers, queens, and males. Only the queens and males possess wings at certain periods of their development. The female workers never are winged, and frequently are comparatively small in size. In some species, the queen is several thousand times larger than the workers of her colony.

Perhaps you have seen, on a still, sultry afternoon, winged ants swarming in the air. These are males and females on their honeymoon flights. As if by a prearranged signal, all winged inhabitants of hundreds or thousands of colonies take to the air at the same time. Later most of the females pick out new home sites, which may be a hole in the earth or a tunnel beneath a stone, shed their wings, and settle down to raise a family. From this time until the first brood is hatched, the typical queen does not eat or engage in other activity. Her massive wing mus-

PREPARING LIGHT FILTER. Colored water is poured into a flask which is held in a wooden stand which is built as described in the text of this article. Light passing through the flask of colored water and falling upon the specimen increases its visibility

In preparing an ant specimen for observation beneath your lens, it is dissected in a drop of water on a hollow-ground slide as is shown in the illustration below

Left, magnified view of tiny hooks found along the front edge of an ant's smaller wing. These hooks fit into a groove in the rear edge of the larger wing so they lock wings together



Enlarged view at left of droplets of fat found in the body of a female ant. These furnish food during the insect's egg-laying period

By

Morton C. Walling

cles, no longer required for locomotion because the wings have been discarded, are absorbed and converted into egg material. Individual ants in the first brood are small, because of the limited food supply. They assist their mother by bringing new food into the nest, so that the second and subsequent broods are made up of normal-sized individuals. A queen ant may lay eggs and raise families for many years. This life cycle is not followed by every ant species, but is typical of many of them.

Examine a winged ant under the microscope. You can see without much trouble that the wings, of generous proportions, require powerful muscles, so that the way in which the queen ant can exist without food while her first batch of eggs are developing becomes evident.

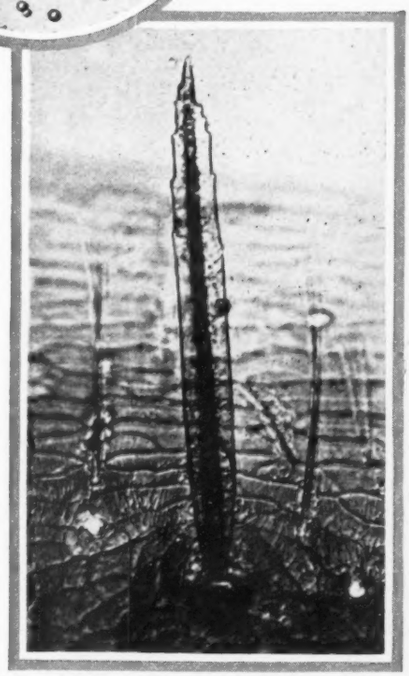
When you look at a worker ant, at moderate magnification, you will be struck by the well-polished appearance of her body. The armor plate fairly glistens, with a finish rivaling that of a shiny motor car. Although your specimen spent much of its time in or on the ground, you fail to see particles of dirt on its body. Why is this?

FOR the answer, switch to a somewhat higher power and examine carefully one of the fore legs of the ant. There, near the outer end of one of the sections (the tibia) is a delicately formed comb, with perfect rows of tiny teeth. It folds down, like a pocketknife blade, against the adjacent leg section or metatarsus, which likewise is toothed. Now you know how the ant keeps herself clean. She combs her body with her fore legs, drawing her other legs and antennae through the notch formed by the comb and metatarsus. Then she cleans the combs by passing the teeth through her mouth. She does not eat the dirt thus obtained, but sidetracks it to a little pocket lying just inside the mouth opening.

In this pocket she also stores, temporarily, any solid food that she may have eaten. It remains there until all the juices it contained have been pressed out. Then the pellet, formed by compressing the food and dirt particles in the pocket, is discarded. The ant, therefore, actually does not eat solid food, but only liquids. Sometimes it finds these liquids ready to drink. At other times it has to extract them from solid material in the pocket, or by squeezing a bit of solid food between its powerful mandibles. By carefully dissecting the head of a large ant, you may be able to find the little pellet in the pocket just inside the mouth.

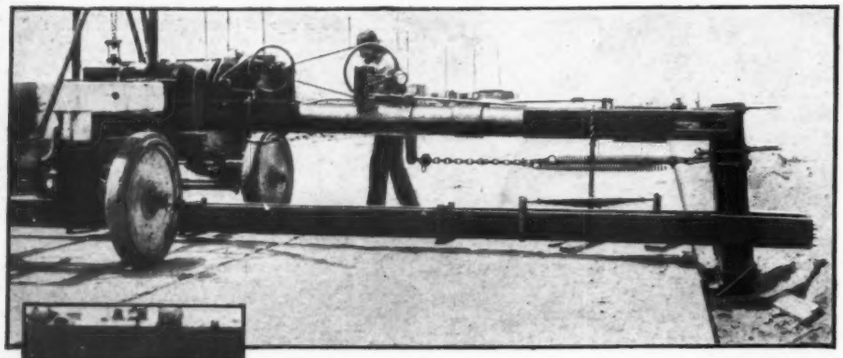
The head and mouth parts of ants vary according to species. Generally there is a prominent pair of mandibles, usually toothed. These operate somewhat like the jaws of claw-type pincers. The ant uses them as its principal tools, much as you use your hands. With them it captures and kills other insects and presses their juices out for food; it tunnels through earth or wood; it uses them as weapons in fighting; it employs them as tongs for carrying eggs, young ants, and all sorts of objects.

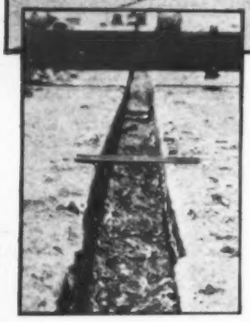
In addition to the mandibles, the mouth parts that your microscope will reveal include the upper lip, or labrum, lower lip, or labium, and a pair of maxillae. The labium and maxillae are equipped with pairs of jointed palpi, which are sensory organs probably *(Continued on page 94)*



The spike in the center of this picture is a hair on the body of an ant. It is magnified about 650 diameters. Note the ridged nature of the insect's body as seen in microscope

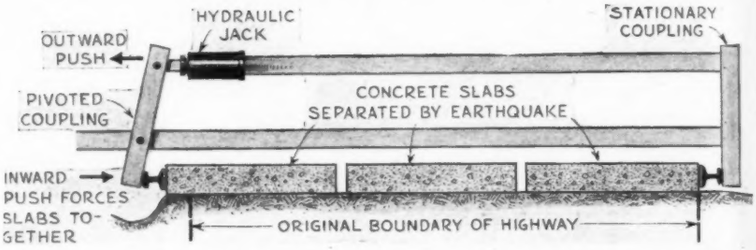
Giant Pincers Repair Road Torn Up by Quake





Above, working end of big highway jack which, run by hydraulic power, was used to press back into place fifty-ton blocks of concrete torn out of place by quake

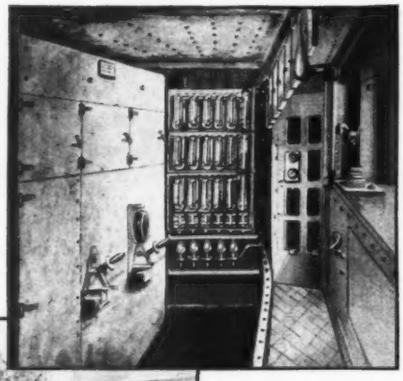
Left, section of road showing gaps in the concrete. Right, diagram illustrating the operation of giant pincers

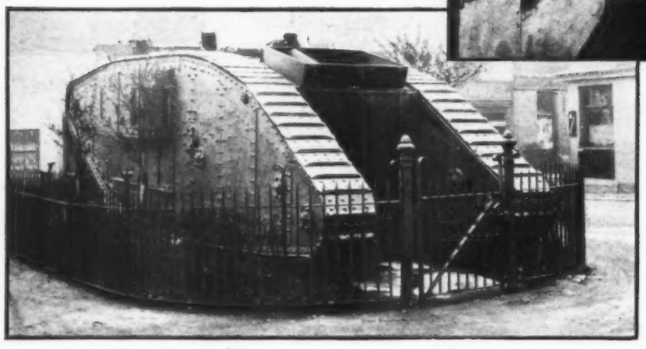


When an earthquake played havoc with California highway some time ago, engineers faced a difficult repair job. To close the gaps, they devised a giant pair of pincers with jaws thirty feet apart. An hydraulic jack inserted in the upper jaw provided the force to operate the pincers, which were mounted on a trailer. To align a section of road, the stationary jaw of the pincers was jammed against one side, the pivoted jaw against the other, and the hydraulic jack set in operation. Under terrific pressure, the fifty-ton blocks of concrete slid back into place. Thus 3,000 feet of highway was realigned.

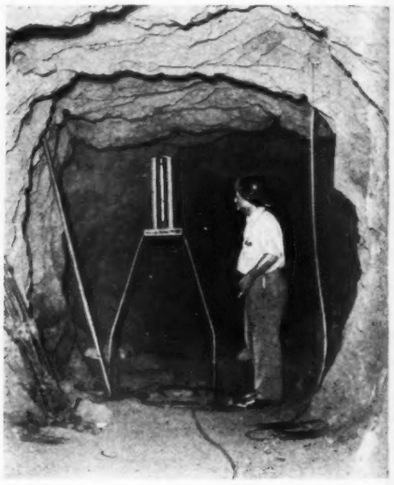
OLD WAR TANK NOW LIGHTING STATION

In Ashford, England, an old war tank is finding a peace-time use as a local electric light plant's switching station. A central position was needed by the company and the town authorities gave them permission to use the tank if they did not change its appearance. The interior of the tank provides room for a small switchboard and three high tension cubicles. Meanwhile in exterior appearance, the tank still remains as a memorial of the World War as it was not necessary to make outside changes in making it a light station.





Above, interior of war tank fitted up as lighting station. Left, exterior of the tank, a war memorial in English city

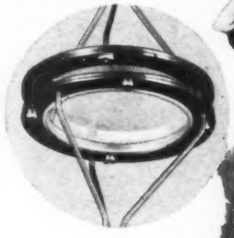


NEON LIGHTS IN TUNNEL WARN MEN OF BLAST

Lights of red neon tubing, placed on curves in tunnels, protect workers in the ninety-one miles of shafts being driven by the Metropolitan Water District of Southern California to serve as aqueducts. The glowing strips of light, which can be seen long distances, warn workmen of impending dynamite explosions, of which there are 2,000 daily. The photograph above shows one of the warning signals.

GLASS DISKS STICK SOLIDLY TOGETHER

In a striking demonstration of the accuracy with which optical glass can be ground, two pieces of such glass clung together so tenaciously that the weight of a 105-pound woman failed to separate them. The tenacity with which the pieces stuck together was due solely to the attraction of the molecules in one piece for those in the other. It was estimated that the pieces were capable of resisting a separating force of ninety-five to 100 pounds. The surfaces of the glass had been polished to within a millionth of an inch of perfect flatness.

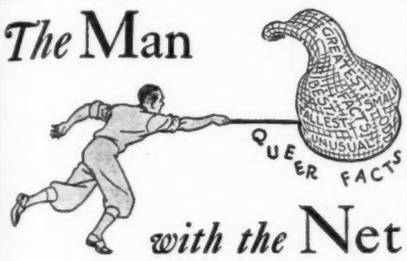


Above, close-up of disks of glass that stuck so tightly together they supported woman, as at right

WOMEN FLYERS TO GET FORCED-LANDING PRIZE

A prize for forced landings has been announced by the president of the Ninety-Nine Club, American organization of women pilots. It is to be awarded each month to the girl flyer who lands at the greatest number of airports, successful forced landings counting two points and dead-stick landings made in pastures and fields, three. The purpose of the prize is to call attention to the nerve of women pilots in emergencies.

The Man with the Net



CHEMICALS *extracted from petroleum are so numerous the list fills a volume of 1,200 pages.*

JACKKNIVES *were used 1,000 years ago. In Germany, archaeologists have just uncovered a knife with a folding blade which they estimate is at least ten centuries old.*

CANDY *phonograph records have been patented in England. When you get tired of hearing the record, you can eat it up!*

AMERICANS *still buy $300,000 worth of buggy whips each year.*

MONTANA'S *geographic center is in a kitchen sink. State surveyors, seeking the exact center of the state, found the point was in the town of Lewistown, in the home of a doctor and in his kitchen sink.*

SUNFLOWERS *wake up at midnight. Records kept by scientists at the Boyce Thompson Institute for plant Research, Yonkers, N. Y., show that the cells speed up their work after the clock strikes twelve. Formerly it was assumed that the spurt in activity started at sunrise.*

COLLEGE *students are getting smarter. Out of 188 colleges, 157 report higher marks on intelligence tests now than before the depression began.*

WORMS *recently stopped a train in Texas. Tens of thousands covered the rails, caused the drive wheels to slip and brought the train to a halt.*

GOLDEN EAGLES *fly faster than two miles a minute. Timed over a three and a half mile course in the mountains of Scotland, one was observed to be making this speed, at the same time gaining 1,000 feet in altitude.*

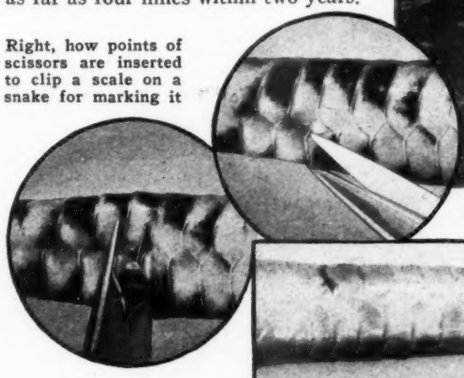
EIGHT *hundred and fifty words are all you need to know to carry on an ordinary conversation.*

HEAT *regulates the speed of ants. At fifty degrees F., they run fifty-two feet an hour; at 100 degrees, 780 feet an hour. By glancing at a thermometer, a Harvard scientist found, he could tell within five percent of how fast an ant would be moving. And by timing an ant, he could determine within one degree how hot the day was.*

SNAKES MARKED FOR STUDY OF TRAVEL

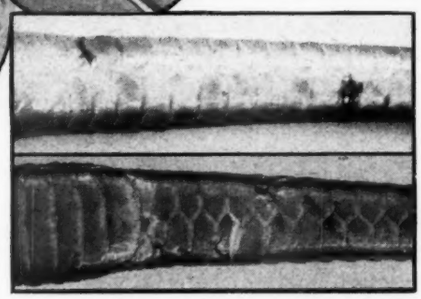
So THAT the habits of snakes, particularly their travel, may be accurately studied, a Texas expert has devised a singular method of marking them. Instead of branding the reptiles, as is done with cattle, or banding them like birds and bats, this expert clips scales on the underside of their tails. The operation, accomplished quickly and without apparent pain to the snakes, leaves a permanent scar. Beginning with the second scale of the tail, scales are clipped from both the left and right sides. A card record is kept for each snake, showing which scales were clipped on either side. Studies conducted thus far with marked snakes show that some remain in practically the same spot indefinitely, while others wander as far as four miles within two years.

Catching a water snake at night for marking



Right, how points of scissors are inserted to clip a scale on a snake for marking it

Above, how the clip is completed. When it is done in this way, the snake is not harmed



Left, top picture shows marks, made on a garter snake, after five months. Bottom, tail of a snake with three markings, one recent and two old

NIGHT DEPOSITORY FOR TAILOR SHOP

Garment chute on door of cleaning shop, with instructions for using

To PERMIT customers, after a shop has closed for the day, to leave clothing for cleaning, pressing or repairing, an inventor in East Orange, N. J., has developed an ingenious receiving chute. The receptacle is fitted to a narrow opening in a door or outside wall, and clothing dropped into it falls into a hamper inside the shop. The customer writes his name and instructions regarding the clothing on paper which appears in a slot below the main opening of the chute. Then, by means of a wheel, the customer winds the paper on a concealed roll so that the next customer finds a blank space awaiting him. Since the sequence of names on the roll of paper corresponds to the position of the clothing, it is easy to identify the garments.

The chute as seen from inside the shop. The hamper in the foreground receives garments

DAYLIGHT TOP ON CAR IS UNBREAKABLE

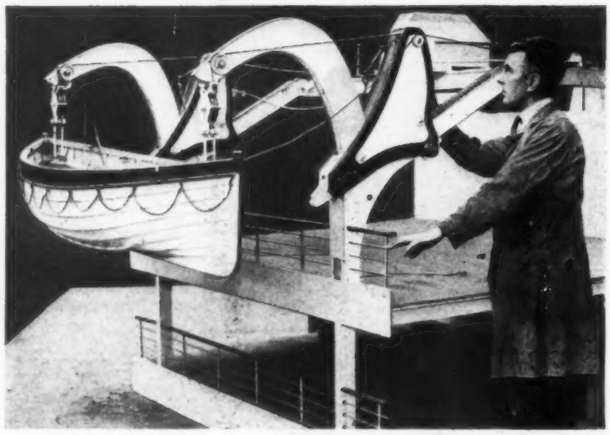
AN AUTOMOBILE roof panel just invented in England will admit light, yet cannot be broken with a hammer. The old type sliding panel, widely used on English cars, admits abundant light and air when open but is difficult to make water-tight when closed in rainy weather. The new panel overcomes this objection. It consists of a steel mesh covered with a substance that resembles glass.

PUTS LADDER ON WHEELS TO SPEED ORCHARD WORK

TO SAVE himself the labor of carrying a heavy step ladder, a resourceful orchard worker built the ladder on wheels illustrated above. Easily trundled about by two projecting wooden handles, it saves time and trouble in cleaning trees and removing dead wood. Padding on the ladder protects the trees from damage. The wheels were obtained from an old buggy, but the inventor says a pair from an old auto or from a worn out and discarded cultivator would do as well.

GRAVITY LOWERS LIFEBOATS ON SUPER-LINER

GIANT lifeboat davits, now being installed on Great Britain's super-liner, the *Queen Mary*, designed for unusual safety, operate solely by the force of gravity and can be controlled by a simple lever. When the lever is touched, the counter-weighted arms of the davits drop forward after the fashion of a bascule bridge, swinging the lifeboat clear of the ship's side. Heavy cables then unreel to lower the boat into the water.



Model shows how lifeboats for biggest ship are lowered by gravity

Below, African watch tower from which a lookout gives warning of approaching bands of apes

TOWER WATCHMEN SOUND WARNING AGAINST APES

TO KEEP their cultivated fields from being invaded by apes, natives of British East Africa erect curious lookout towers. The apes, traveling in quest of food, are attracted by the growing crops and, unless driven off, destroy them. Natives post a lookout in the tower, and at the first appearance of the beasts, the lookout sounds an alarm and the apes are driven away.

ENTIRE FACTORY BUILT IN THREE DAYS

USING his own method of slab construction, a builder recently completed a factory at Kenilworth, N. J., three days after work was started on the foundation. The concrete walls of the building had been cast previously in four-foot vertical slabs. After the foundation was laid and the roof erected, these slabs were lifted by a derrick mounted on a motor truck and set in place. Steel window sash had been cast directly into the slabs, leaving the glazing of the sash the only operation remaining to complete the building. The factory is forty-eight feet long.

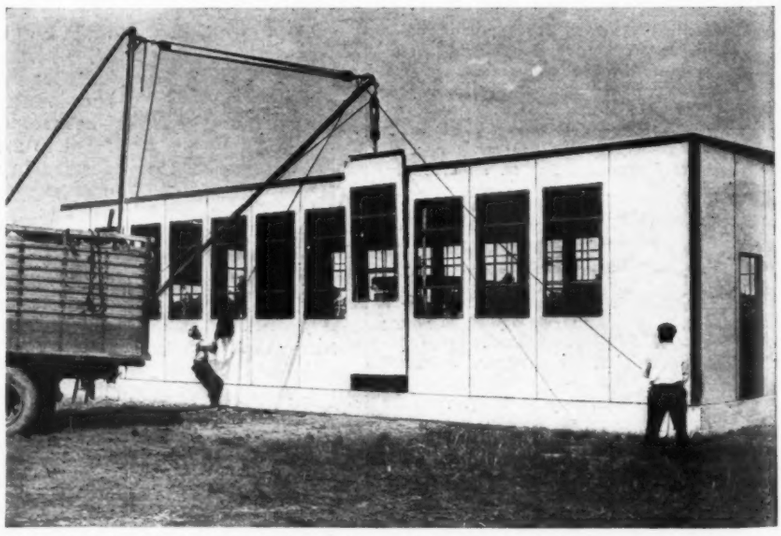
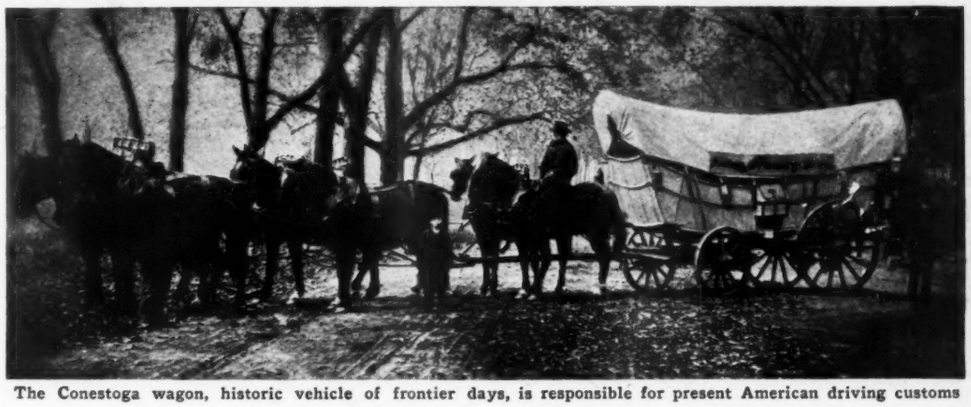


Photo shows four-foot concrete slab being hoisted into place in a building erected in three days

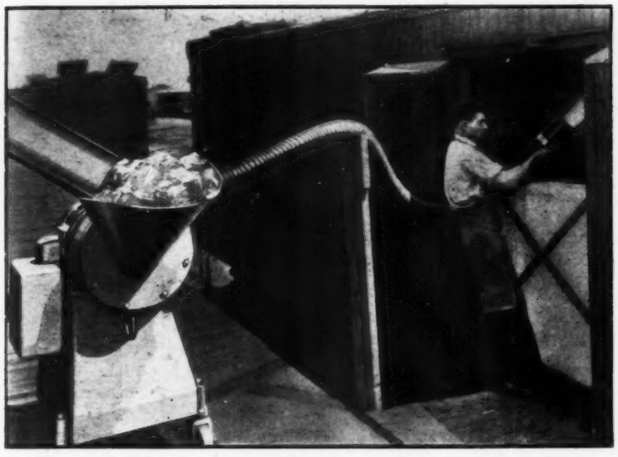
Why We Drive on the Right of the Road

HOW many American drivers, to whom keeping to the right is second nature, know the reason for the custom? Behind this familiar rule of the road lies an interesting and little-known story. Early colonists of British origin rode on the left of a highway as their forebears had. The British custom, which is still observed in England, was originally a protection against banditry. Travelers kept to the left so that the right, or sword, hand would be free to deal with highwaymen. With the development of wagons and coaches, practices diverged. British drivers continued keeping to the left so that the coachman, sitting at the right of his seat to obtain free play for his whip, could see that the wheels of his coach did not collide with those of passing vehicles. Other European countries, however, adopted the postillion system of driving, in which the driver or postillion rode one of the wheel horses, naturally choosing the left one so that he might wield his whip to best advantage. To obtain a clear view of other vehicles from this position, it was necessary to keep to the right. The same system was adopted by drivers when the distinctively American vehicle, known as the Conestoga wagon, came into use in the United States early in the last century. Built like a boat so that it could be floated across frontier streams, it offered no interior accommodations for a driver. Consequently he rode the left wheel horse, or the "lazy seat," on the left side of the wagon, and drove on the right side of the road. Other vehicles had to follow the deep ruts cut in the road by these heavy pioneer wagons.



The Conestoga wagon, historic vehicle of frontier days, is responsible for present American driving customs

ICE SPRAY COOLS REFRIGERATOR CARS



Ice is sprayed over the car and its contents to prevent spoilage

SPRAYING refrigerator cars and their contents with pulverized ice is a recently adopted means of making vegetables and fruit shipped to market by railroad arrive in perfect condition. The ice is shot through a long, flexible hose by a high-power blower. This preliminary chilling, applied before the doors of the car are closed, prevents spoilage that sometimes occurs before the food can be cooled by cake-ice.

DOOR MATS MADE OF OLD AUTO TIRES

DISCARDED automobile tires can be converted into attractive door mats, with machines devised by a Kansas inventor. One of the machines cuts the old tire into strips and the other punches holes in them at regular intervals. With a second punch, rubber washers are stamped out of the old tire. The strips are fastened together by means of a series of wires, the washers being used to separate the strips and form a grill pattern. Many designs are possible.

Old auto tires are cut up to form strips and washers, which are then strung together to make attractive and practical door mats

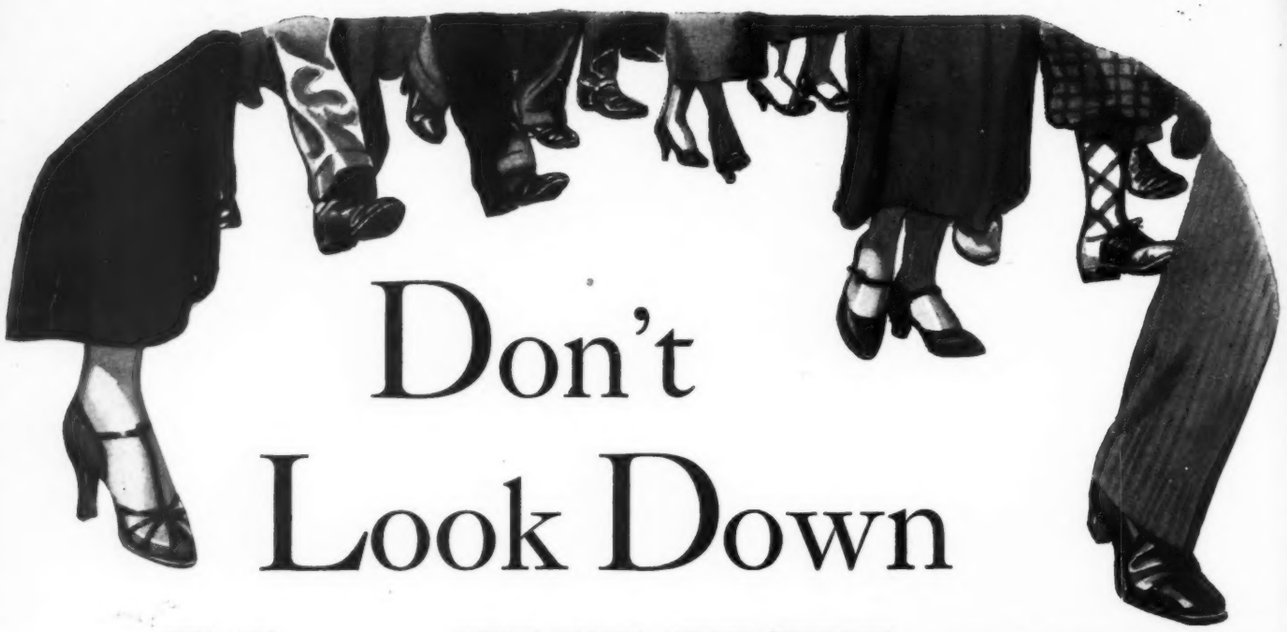
Easily attached to a shelf or a ledge, this portable socket will solve the problem of lighting jobs in dark corners

Left, reel used as an emergency lamp

A clip of flexible wire makes it easy to clamp the reel in many odd places

REEL HOLDS CORD FOR LAMPS AND APPLIANCES

A NEW electric accessory, comprising a socket and fifteen feet of connection cord on a built-in reel, provides a portable lamp for out-of-the-way places. The cord is plugged into the nearest outlet and the desired length pulled out. A clip on the base of the reel permits it to be attached to a bed, the arm of a chair, or a shelf near a workbench. The device also serves as an extension for appliances with cords too short for the use intended.



Don't Look Down on Your FEET

By ARTHUR GRAHAME

"I CAN'T think when my feet hurt," Abraham Lincoln once complained. Neither can *you* think straight when your feet hurt. Neither could Professor Albert Einstein or any other intellectual giant. As robbers of mental and physical efficiency, and as joy chasers, a pair of protesting feet are in a class by themselves.

So don't neglect your feet. It doesn't pay. Respect them and treat them right, and they'll carry you pleasantly through life. Treat them badly, and they will set up a chorus of aches and pains that will make your days miserable.

Few people realize how much they use their feet. Tests have been made to determine how far we Americans of the motor age walk. People of various ages and occupations were equipped with pedometers, sent about their ordinary daily activities, and their pedometic readings carefully tabulated. The results were astonishing.

One active schoolboy clicked off an average of fifteen miles a day! A schoolgirl averaged eleven and one-half miles. A business man who played a good deal of golf walked nine miles a day. A saleswoman's average was eight miles.

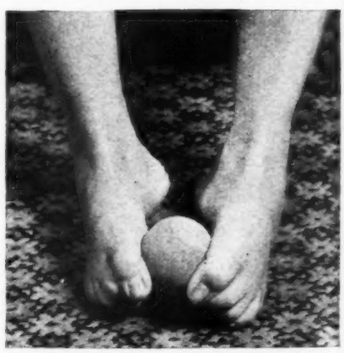
The average distance walked in a day by average people was found to be 18,008 steps—seven and seven-eighths miles. That amounts to 2,870 miles a year—close to the road distance between Washington and Los Angeles or between Boston and Yellowstone Park. If you live a normal length of time, and are normally active throughout your span of years, you'll have to depend on your feet to carry you over a total of some 175,000 miles. You'll walk a distance equal to seven trips around the earth at the equator.

Professor G. Elliot Smith, noted British anthropologist, reports that recent discoveries show that the prehistoric Peking Man, who lived in the caves of northern China over a half million years ago, had hands like the hands of a modern man, but that his feet were like the feet of an ape. He must have walked with his toes turned in, as an ape walks.

BUT since the dawn of history there has been no fundamental change in the human foot. Roman legionaries, who hiked their fifty miles a day on forced marches when the Carthaginians invaded Italy more than twenty centuries ago, marched with the same efficient tractive arrangement of twenty-six small bones held together by a network of ligaments as do the soldiers of today. The feet of the savage peoples of the present differ but little from the feet of civilized men. The big toe of the savage is more widely separated from the other toes, and the toes are of more nearly the same length than are the toes of shoe-wearing people, but they are exactly the same as were the feet of savages 4,000 years ago. The feet of a baby born of civilized parents today are exactly the same as were the feet of a baby born of civilized parents centuries ago. Nature has made no change in the human foot, but the feet of civilized men have been changed by many generations of shoe wearing, and the feet of many persons have been cramped and sometimes deformed by their owners' vanity or thoughtlessness in wearing improperly shaped or poorly fitting shoes.

It is quite possible that it was from the human foot that the early engineers got the idea of the arch as an architectural weight carrier. Certainly the two main arches of the foot, taking into consideration their small size and the amount of weight that they must carry and the severe and varying strains that they must withstand, are highly efficient.

Standing on a book, with the toes grasping the edge, and then rising on the balls of the feet, strengthens weak arches



Another good exercise for toes and arches is shown above. Grasp the ball with the toes, while sitting down, and raise it

Feet can be developed in this manner. The idea is to pick up a small marble

One of these main arches, the longitudinal, extends from the heel to the ball of the foot. The degree of its arch varies with races and with individuals. The arches of the moccasin-wearing American Indians usually are high. The arches of members of the white race normally are high. The arches of Negroes nearly always are low. This does not mean that they all have weak feet, although an army surgeon who has served in the field with both white and Negro troops tells me that white men's feet are much the stronger, and their marching better. As a general thing, the heavily built members of any race have lower arches than do those of lighter weight and are the ones who suffer most from foot trouble.

THE other important arch of the foot is the anterior, or metatarsal, arch. It is formed by the heads of the bones of the forefoot, and extends from the inside to the outside of the foot at its ball.

These two arches are the real foundation stones of the human body. If, in a building, the foundation gets a fraction of an inch out of alignment, a weakness is likely to develop in an upper wall. In the same way, if the foundation arches of the human body are weakened, flattened, or forced out of their normal position, ill effects are likely to be felt in almost any part of the body.

It is estimated that nine people out of ten suffer from more or less serious foot trouble, and it is a known fact that four out of every five men who failed to pass the army physical examinations during the World War were rejected because of their defective feet.

Feet that hurt are so common that many people have come to regard them as a natural ill of mankind, and do little to get relief. There was, for example, a gentleman of seventy-five years who told his physician that for a long time he had felt severe pain under one of his metatarsal arches. The physician made an examination; then extracted something that looked like a quill. The patient, a Confederate veteran, then remembered that during the Civil War he had kicked a porcupine that had invaded his tent. The results had been painful to the soldier, and an army surgeon had spent half an hour picking quills out of his foot. But he had missed one, and the old gentleman for years had endured the pain that it caused, putting it down casually to "sore feet." The same degree of pain in any other part of his body would have sent him hurrying to a doctor with a demand for quick relief.

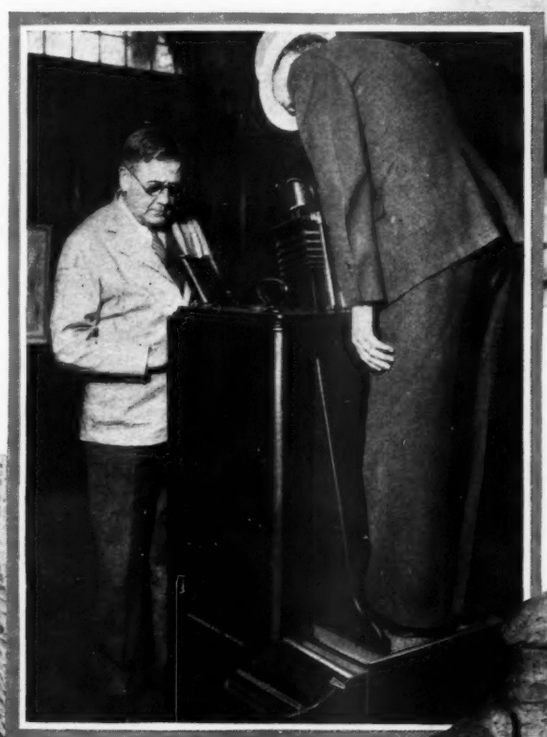
Most foot pains aren't caused by accidental injuries. Neither are they caused by congenital foot troubles. They are the result of wearing improperly shaped shoes, or shoes that are either too large or too small.

When man began to wear foot coverings, it was solely for the purpose of protecting his feet from cuts and bruises. Early sandals, which did not in any way constrict the foot, were real orthopedic shoes. So are the sandals worn by Japanese coolies today. And, by the way, some foot specialists think that our hosiery manufacturers would do our feet a big favor if they would make socks and stockings on the Japanese model, with a separate compartment for the big toe.

Civilized people of the more prosperous classes soon became discontented with mere sandals. Spending most of their waking hours on horseback, and looking down on people who walked, they thought little of foot efficiency. In that respect they were like our cowboys, who still cling to their traditional high-heeled boots under changed working conditions that make them spend much of their time in discomfort afoot. As the years passed, the shoes of upperclass people became things of beauty more than of utility. Heels, which grew ever higher, were placed under the rear portions of footgear made of silk and of richly decorated leather.

(Continued on page 110)

The feet of some natives in palm-growing regions are so prehensile that they can climb trees by grasping them with hands and feet



X-ray shoe-fitting machine. The customer stands as shown and he can then see the bones of his feet through the shoes he is trying on. In this way he can tell if the bones are being forced out of position

Natives in the Belgian Congo wear sandals like those seen below. Note ball between toes that holds sandal

Here are the bones of a normal foot. Their delicacy suggests the ease with which shoes can cramp their movement

GAUGE SHOWS WIND'S EFFECT ON CAR

Above, homemade air-speed gauge mounted on radiator and ready for use. Right, the dial of the gauge with each scale division representing ten miles an hour

AN AIR-SPEED indicator, resembling those used by airmen, has been built into a radiator ornament by a California motorist. Registering the relative velocity of his car and the wind, in miles per hour, it affords him an accurate way to observe the effect of streamlining in reducing wind resistance. The operating mechanism, enclosed in a double funnel or venturi tube, includes a diminutive propeller that is turned by the driving force of the wind until counterbalanced by the tension of a coil spring. An indicator, fixed to the same shaft as the propeller, then shows the air speed directly, reading in tens from zero to 100 miles an hour. In still weather, this speed equals the reading of the car's speedometer, while it is higher against a headwind and lower with a tailwind. Tests with the homemade instrument have shown that a car's performance varies markedly in traveling with or against the wind.

Right, close-up of the unusual gauge showing the tiny propeller that, turned by the wind, moves the needle across dial's face

SIGHTING OUTFIT HELPS FOOTBALL OFFICIALS

USING a newly invented sighting device that looks like a surveying instrument, a football linesman can measure yardage with absolute accuracy. Invented by a California coach, the instrument consists of two poles connected by a ten-yard chain. One pole carries a sighting tube with lenses in each side as well as in one end. A flag marker is set up at each end of the sideline and the tube is so adjusted both flags are reflected in the lenses.

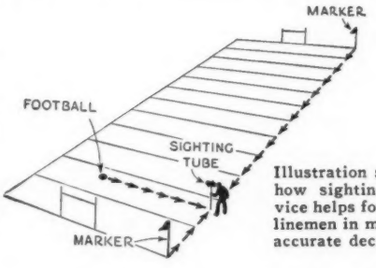


Illustration shows how sighting device helps football linemen in making accurate decisions

LIFE PRESERVER FORMS A STORMPROOF CABIN

ALMOST as comfortable as if he were on dry land is the occupant of a new life preserver made of two rubber sections that can be inflated with air. The interior forms a roomy cabin, while a stormproof window affords a view of the surroundings. A pole and flag at the top constitute a signal to attract the attention of passing vessels so that the person within may be rescued. The photograph above shows the device in the water during a recent test of its efficiency.

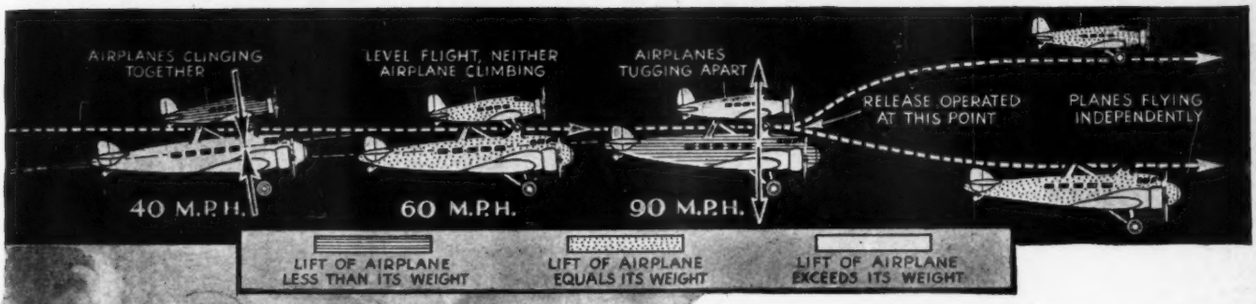
NEW ELASTIC THREAD CONTAINS NO RUBBER

A THREAD that stretches, yet contains no rubber, is the discovery of a French inventor. The secret of the elastic thread lies in the method of weaving it, which is said to be applicable to cotton, silk, or wool with equal success. Tests by stretching the thread and soaking it under water for forty-eight hours are reported to have revealed no flaws. Its application is foreseen for clothing of all sorts, including dresses, bathing suits, hats, shoes, and all sports apparel.

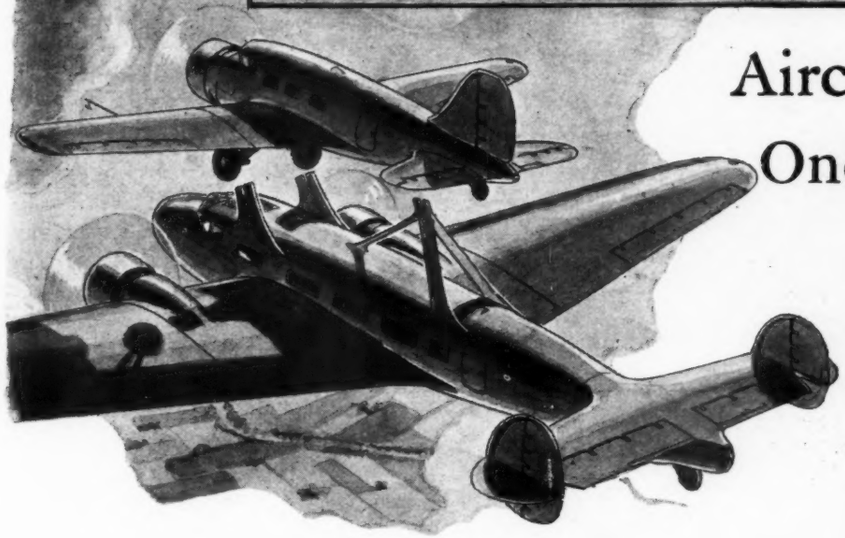
INSECT TRAPS RAISED BY KITES

HUGE kite-borne nets are being used in England to capture from the upper air specimens of insects invading the country. The kites used in the work have saillike fins to give the greatest possible lifting power. Carried aloft by these kites, the conical nets stream through the air like giant wild-socks, scooping up the insects in their path. The nets, when they leave the ground, are closed by a drawcord laced through them a short distance from the throat. An automatic control opens them when they reach the desired height. The traps close as the kites are drawn down.

Traps, attached to kites, are carried aloft to capture insect pests


AIRPLANES CLINGING TOGETHER
LEVEL FLIGHT, NEITHER AIRPLANE CLIMBING
AIRPLANES TUGGING APART
RELEASE OPERATED AT THIS POINT
PLANES FLYING INDEPENDENTLY
40 M.P.H.
60 M.P.H.
90 M.P.H.
LIFT OF AIRPLANE LESS THAN ITS WEIGHT
LIFT OF AIRPLANE EQUALS ITS WEIGHT
LIFT OF AIRPLANE EXCEEDS ITS WEIGHT

Aircraft Can Fly As One or Two Planes

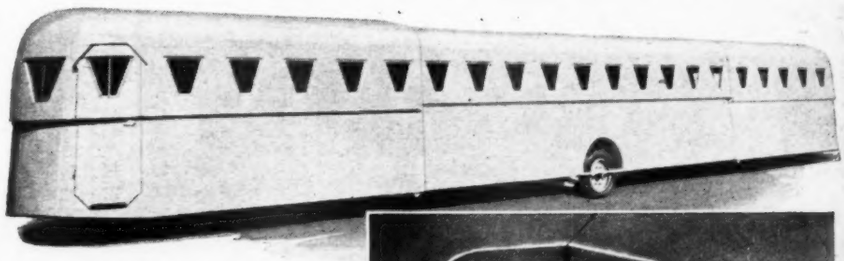


Above, duplex plane in the air with the upper plane just leaving the carrier for an independent flight. At top, diagram explains how the planes separate in mid-air

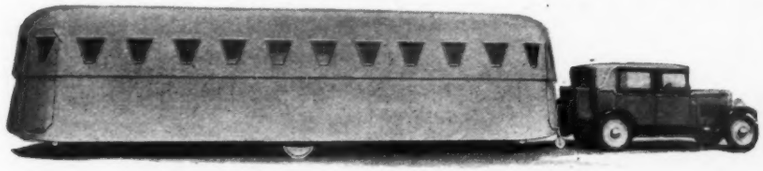
A FLYING craft that splits in mid-air into two separate planes, each capable of flying independently, has just been patented by a British inventor. The composite machine comprises one plane mounted and locked in a cradle on the back of another, in such a way that the pair may be flown as a unit and behaves precisely like a conventional craft. Whenever desired, however, the two planes may uncouple themselves and go their separate ways. Thus two transport craft could be hitched together to operate over trunk sections of airways and could separate in the air to serve divergent branch routes, eliminating time lost in landing and transferring passengers, mail and cargo. Another possible application is foreseen in military use, where a machine that could multiply itself and beset a bewildered adversary from two sides at once might have a marked advantage. Joining two planes so that they do not interfere with each other during a take-off and in normal flight, but will separate quickly and positively when desired, without recourse to mechanical complications such as a tiltable launching platform, presents a tricky problem in aerodynamics. To solve it, the inventor has chosen different wing shapes for the two planes, which give them curious flying characteristics. In the take-off and at ordinary flying speeds, the twin planes tend to cling firmly together, because the lift of the lower plane exceeds its own weight, while that of the upper plane is less than its own weight. To detach the planes, the composite machine speeds up and correspondingly flattens its flying angle, or angle of attack, automatically reversing the previous situation. Operated at this flattened angle, the lower plane no longer is self-supporting and tends to fall, while the upper plane is tugging strongly upward. Consequently, when one of the pilots operates a release that uncouples the upper craft, the two planes leap apart so swiftly that there is no danger of mishap. After dropping away, the lower plane rights itself to regain its own lift, and the two planes fly on independently of each other. The upper of the two planes, as at present designed, is considerably smaller than the lower plane but its range is wide as it is carried to the scene of action.

NEW TELESCOPE TRAILER OPENS OUT TO FORM REAL HOME

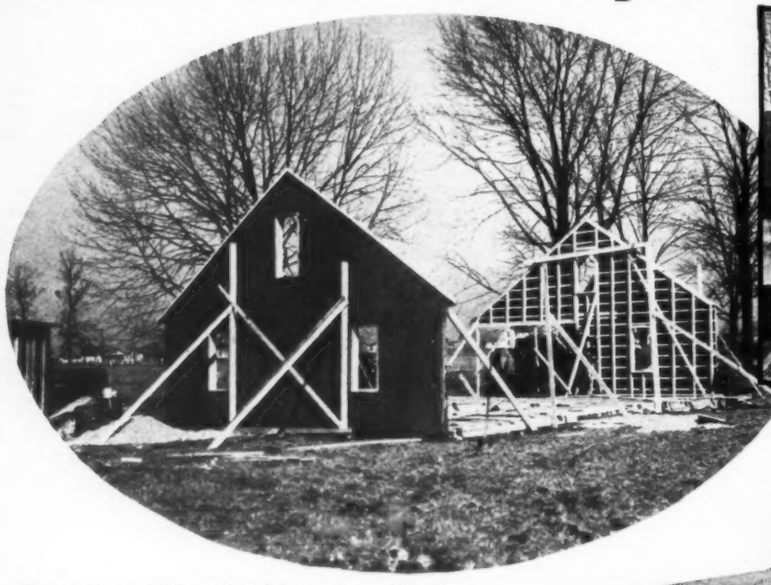
CONTAINING, when extended, as much floor space as a small four-room bungalow, an automobile trailer recently developed by a French inventor can be telescoped for towing into a length of only thirty-seven feet. Extended to its full length of fifty-five feet, the unit contains space for kitchen, dining room, toilet room, and living room. Built-in divans in the living room can be pulled out to serve as beds, thus converting it into a sleeping compartment. Except for the frame, the trailer is built of plywood and is lighted by forty-eight windows. Most of the weight is ahead of the axle, and this end is supported in towing by an idler wheel.



Above, telescope trailer extended to full length. Right, interior of the extended trailer which contains several rooms. Below, the trailer as it appears for travel



House of Metal and Asphalt Built at Low Cost



End sections of "tin and tar" house braced in place

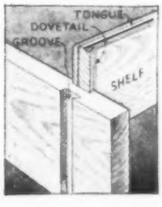
Asphalt is spread on the metal roof

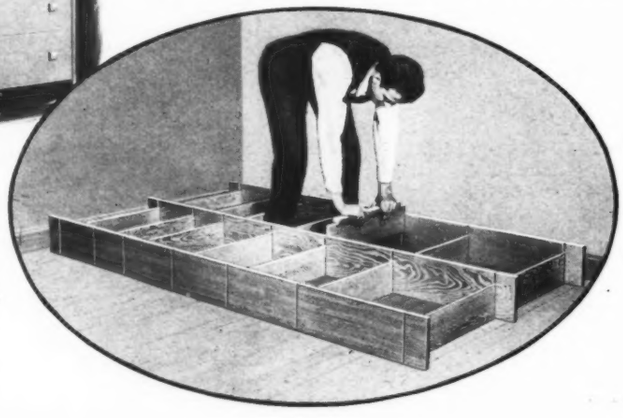
Walls are assembled flat on the ground and an asphalt composition is poured on

A HOUSE of "tin and tar" just completed by a Middletown, Ohio, inventor demonstrates his plan to save one third of the usual cost of a home by building it of corrugated sheet metal and asphalt. Walls are assembled flat on the ground by nailing sheet metal to wood studding. An asphalt composition is then poured on the metal to serve as a binder, and stucco is applied. The roof is of similar construction except for the stucco finish, and inside walls have a finishing coat of plaster. The floor is built directly on the ground, using a preliminary layer of gravel and covering this with the same asphalt composition.

PRE-CUT JOINTS AID CABINETMAKING

SHELVING and cabinets can be built at home with no tool except a hammer, by using a new kind of pre-cut lumber. The vertical side pieces and shelves are supplied in standard widths and lengths, and are assembled by slipping dovetail tongues on the ends of the shelves into snugly fitting grooves in the vertical sides. Trim and back lining are attached to the finished shelves by tacking with short finishing nails. Drawers, doors and pigeon-hole compartments can be obtained ready-made for use with cabinets. New sections can be added to cabinets or shelves as the need arises.





Above, cabinet built of new pre-cut lumber with dovetail joints cut at the factory. Drawers and doors can be bought ready-made. Right, assembling a set of shelves with this handy material

ANTI-AIRCRAFT ROCKET CARRIES MACHINE GUNS

ROCKETS as war weapons have been proposed before, but it remained for a Japanese inventor to produce the strange adaptation of the idea pictured above. The self-propelled projectile is reported to be intended for anti-aircraft use, and designed to fire a hail of bullets during its flight, from machine guns mounted around the circumference of the rounded nose. Test flights of the rocket are said to have been scheduled for an early date.

Seat and back of beach chair, below, is attached to roller that winds it up or down

SEAT OF BEACH CHAIR WINDS UP ON ROLLER

THE fabric seat of a beach chair recently invented by an English movie actress can be protected from rain simply by rolling it up as one would a window blind. With the ordinary chair of this type, a sudden shower means a hurried struggle to collapse the chair and to fold the fabric seat into some sort of order. The seat of the new chair is wound on a spring roller attached to the top of the back. In setting up the chair, the fabric is pulled out and the rod, sewn into the lower end, is slipped into grooves in the forward projection of the frame. When the rod is removed from the grooves, the fabric winds itself upon the roller.

GIANT AIR MAPS MADE OF 4,500 PHOTOGRAPHS

ONE of the largest airmaps ever made in America is to aid the Department of Interior in regulating the grazing on Navajo and Zuni Indian lands in New Mexico, Arizona, and Utah. Forty by twenty-four feet, the huge map will be formed by fitting together more than 4,500 individual aerial photographs.

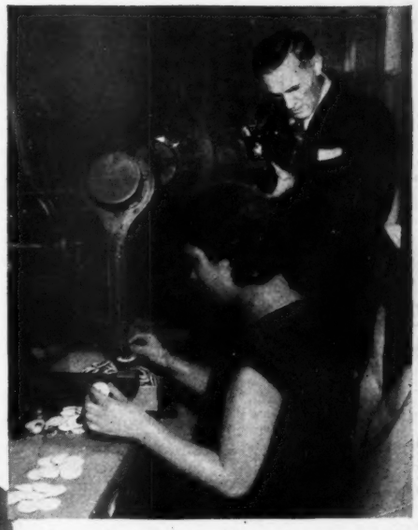
GLIDER STUDENTS TAUGHT BY RADIO

With the portable transmitting station shown, instruction is given to students flying gliders

TIME required to teach students gliding has been reduced at two schools in Germany by the use of radio. Unlike student aviators, the glider tyro is not accompanied by an instructor on his training flights. After preliminary study on the ground, he takes off alone. At the two German schools, the training gliders are equipped either with radio headphones or loudspeakers. The instructor, from the ground, keeps in constant touch with the pupil, warning him when he makes mistakes in steering. The transmitter used is a midget four-tube set, weighing seven pounds.

MOVIE CAMERA SPEEDS FACTORY WORK

AN IMPROVED method of photographing moving objects, such as a workman at his job, employs a movie camera with a constant-speed motor, the number of frames exposed showing directly the time required for each task. Efficiency experts, comparing the films of various individuals, can thus determine the most effective methods and train all workers in them. An innovation in finishing methods permits the film to be cut apart and its sections formed in closed loops for projection over and over again, each loop depicting one operation, making it unnecessary to run through a whole film to arrive at the part desired for exhibition.



A movie camera, with a constant-speed motor, is being used to film factory work

Right, finished film made with a new movie camera that shows time required to complete each part of workman's job

TELEGRAPH POLE RUNS CLEAR THROUGH SMALL CAR

RUNNING into a telegraph pole has been the lot of many motorists, but the rare experience of finding his car impaled upon a pole was reserved for a Seattle driver. Recently this motorist, driving in a blinding rain, ran squarely into the end of an eighty-five-foot pole that was being hauled along the street. The pole plowed through the car, and emerged through the rear window.

FORKLIKE TOOL PULLS TACKS

DRAFTSMEN, housewives, and others who use thumb tacks are spared the annoyance of broken finger nails by a diminutive tool that pulls the tacks regardless of the toughness of the material into which they have been stuck. The tool resembles an ice-cream fork, its two tines being separated by a wedge-shaped groove. The tines are thin and can be forced under a tack head which is almost flush with the material holding it. The tack is dislodged by a quick pull.

Newest Inventions FOR THE HOUSEHOLD

PHONE PAD LIGHT. Attached to a telephone pad, a new shielded lamp, at the turn of a switch, lights up the pad and also the phone's dial so both are clearly seen. Light and pad are of metal and a pencil rack is also provided at rack's end

NEW TYPE FOOD MIXER. Stirring, whipping, creaming, and the like, are easily and quickly done, according to the manufacturer, with this mixer. Held in dish as shown, its blades lift mixture and let air enter freely to expedite mixing

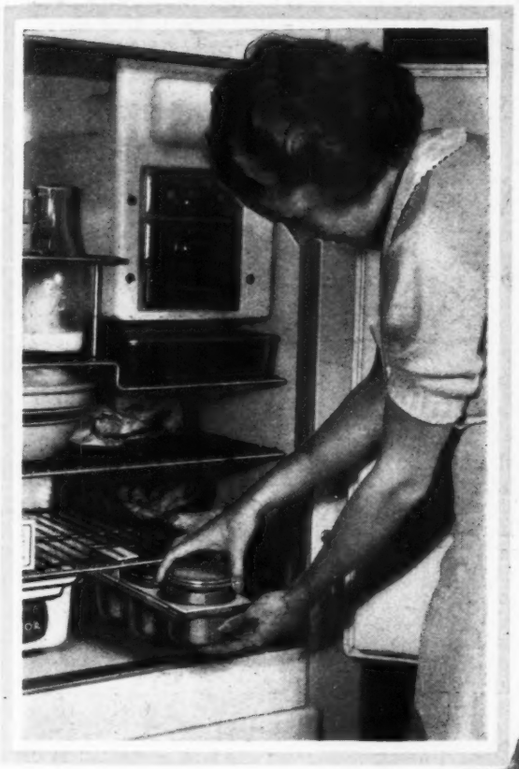
NEW ANT TRAP. The small trap shown above is designed to extirpate ants. According to the manufacturer, it will trap and kill twelve pounds of ants and can be used safely in the home

PLAITS IRONED IN. Garments are pressed and plaited at the same time with this iron recently exhibited in London, England. It comes supplied with attachments for various kinds of plaits and, of course, it can also be used as an ordinary iron. Heated by electricity, its cord plugs into any convenient outlet

VARNISH SPREADER. The long-handled device shown at the right is used to spread varnish on linoleum floors. The length of handle makes stooping unnecessary and it is said the varnish is spread quickly and easily. A removable pad, made of fibers, does brushing. Special varnish for use with the brush is provided. Waterproof, it gives durable finish

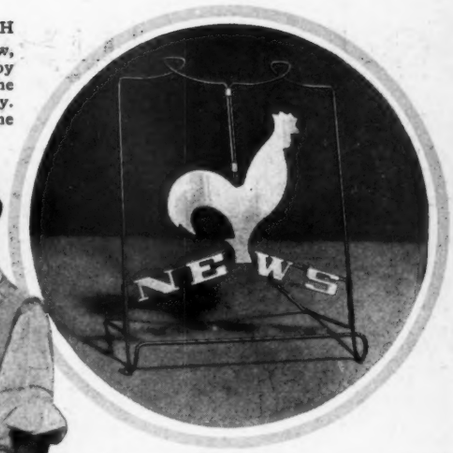
HANDLE ON SHOE TREE. The interlocking wire on this shoe tree, below, controls the spring tension, says the manufacturer. The tree is said to prevent curling and remove wrinkles

AUTOMATIC JIGGER. Liquor is measured accurately and without spilling a drop, it is said, by means of the little device shown above. The jigger is attached to bottle and is filled by tipping the bottle until the rim of the small cup is horizontal. When the cup is full, the flow is at once automatically cut off



SLIDING REFRIGERATOR DRAWER. The space-saving drawer, shown above, is easily installed in any refrigerator and has room for three dishes. It slides in and out, thus bringing the containers within easy reach. Its dishes are made of heat-resisting material and they may be placed in oven for heating before removal to the table

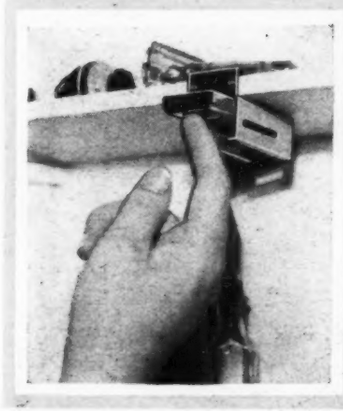
NEW SWEEPING BRUSH
When the sweeper, shown below, is in use, the brush, operated by a lever, automatically directs the dust and sweepings into the tray. Thus the housewife saves time

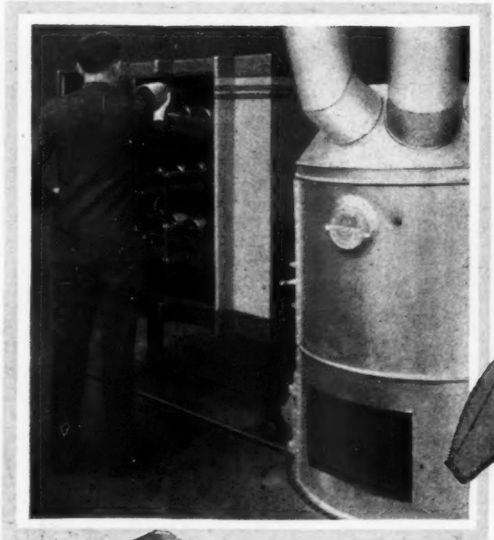


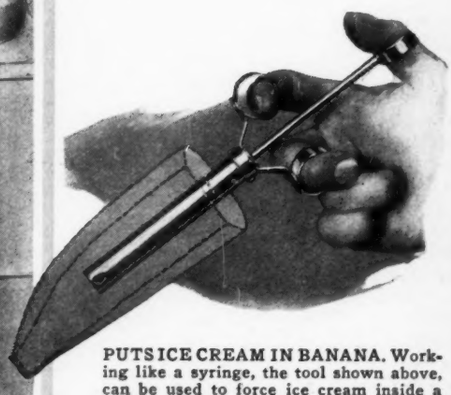
STAND FOR NEWSPAPER. This stand will hold a folded newspaper so that it can be read while the reader is eating. The holder, serving also as book rack, is of brass wire

VACUUM HOLDS THE EGG. Boiled eggs are held securely in this egg cup. A vacuum cup, working both ways, holds container to the plate and grips the egg

SPACE FOR RAZOR BLADES Made of metal, the attachment shown below and at left, slips over bathroom shelf and not only holds the razor but also provides, in its drawer, a convenient place for the blades. The clamp that holds it in place is of spring steel







PUTS ICE CREAM IN BANANA. Working like a syringe, the tool shown above, can be used to force ice cream inside a banana. The heart of the fruit is removed with the plunger and cream then forced in

COAL STICKS FOR FURNACE. Coal, compressed in round, paper-covered sticks, is now on the market. With the appearance of this fuel comes a stoker attachment which can be used with any furnace and which automatically feeds sticks to the fire. The stoker's hopper holds enough coal sticks to last for more than thirty-six hours. They are fed in by a small motor

Touring the Winter Sky WITH AN OPERA GLASS

Above, a star map, made in the form of a lamp shade, is illuminated from within by means of a flash light. In this way the stars you wish to study are easily found

EVEN the most casual spectator of the pageant of the stars cannot fail to notice that the winter star groups offer a far more glorious spectacle than those that sweep across the sky in summer. Chief of them all is Orion. As he lifts his giant frame above the eastern horizon on these December evenings, he brings with him a bunch of constellations unmatched in beauty and interest by any in either the Northern or Southern Hemispheres.

Few among those who look at the stars with pleasure realize what a fascinating journey of discovery those star lands offer to the possessor of even the weakest of opera glasses. To provide an itinerary, for the opera- and field-glass tour, of the heavens is the purpose of this article. An itinerary, however, calls for a map and a time-table. You must, in other words, know where to look, when to look, and what to look for.

A mere star book, or planisphere, does not satisfactorily fill the need of a time-table. When you go out under the dark sky, away from street lamps, you want some map of the sky features that is easy to hold and consult. You do not want to turn pages or hold a chart over your head for flash-light illumination.

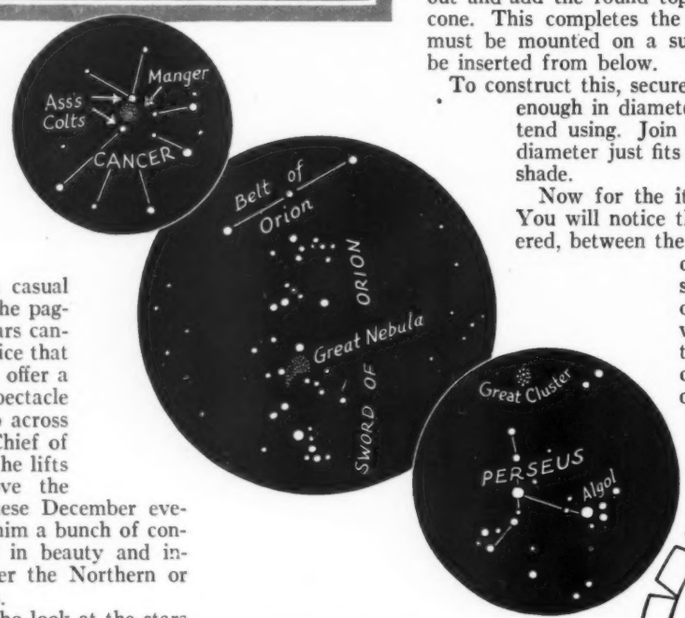
To fill this need the writer has devised a sky time-table in the form of a lantern lighted from within by a flash light. It shows four different translucent maps indicating the star groups in view from horizon to zenith at a definite hour on any night from December 7 to February 20.

Each of these maps shows the sky as it appears when facing a cardinal point at 11 P.M. on December 7; 10 P.M. on December 21; 9 P.M. on January 5; 8 P.M. on January 20; 7 P.M. on February 4, and 6 P.M. on February 20. The lantern accordingly furnishes a convenient guide for stargazing all through the winter season, and as such will be well worth constructing. The photographic illustration shows how the sky time-table is used, and the plans indicate the details of construction.

To build the lantern, first take a sheet of thin but strong tracing paper or cloth, such as architects use for plans. Fasten it firmly over the curving map shown. Adhesive tape is convenient; or use two or three dabs of rubber cement. Then carefully trace the map lettering. This done, mount the tracing with rubber cement upon a piece of stiffer but translucent paper. Cut this out and join the ends to make a conical lamp shade. Cut out and add the round top, gluing its tabs to the inside of the cone. This completes the essential part of the lantern, but it must be mounted on a support into which the flash light can be inserted from below.

To construct this, secure or make a cardboard tube just large enough in diameter to slide over the flash light you intend using. Join this to a cardboard ring whose outer diameter just fits inside the bottom of the conical lamp shade.

Now for the itinerary of various winter sky sights. You will notice that the surface of the lantern is covered, between the time-table charts, with several small, circular star maps. Each of these maps shows in detail one of the principal opera-glass features to be seen in the winter sky. The number on each detail map corresponds to a numbered location in some constellation visible in one or more of the time-table charts.

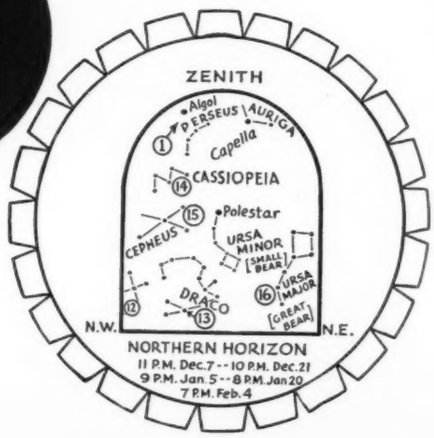


THREE FAMOUS STAR GROUPS

In circle upper left is seen the Beehive as it appears on your lamp-shade star map. This cluster of stars is in constellation Cancer

In center above is the great nebula in Orion. Even an opera glass will show you that what to the naked eye looks like a star is the nebula

In third circle above, and at right, the star Algol, in the star group Perseus, is shown. Its brightness undergoes constant change



Brilliant constellations visible in northern heavens can easily be identified with the homemade device described in this article

MAKING STAR LANTERN
Trace the map shown here and then mount tracing upon a piece of heavier, but translucent paper. The ends are then joined together and the map is mounted on a support so that you can slip a flash light inside to illumine map. Top of shade appears at bottom of opposite page. Trace it also
ZENITH
WESTERN HORIZON
11 P.M. Dec. 7 -- 10 P.M. Dec. 21 -- 9 P.M. Jan. 5
8 P.M. Jan. 20 -- 7 P.M. Feb. 4 -- 6 P.M. Feb. 19
SOUTHERN HORIZON
11 P.M. Dec. 7 -- 10 P.M. Dec. 21 -- 9 P.M. Jan. 5
8 P.M. Jan. 20 -- 7 P.M. Feb. 4 -- 6 P.M. Feb. 19
EASTERN HORIZON
11 P.M. Dec. 7 -- 10 P.M. Dec. 21 -- 9 P.M. Jan. 5
8 P.M. Jan. 20 -- 7 P.M. Feb. 4 -- 6 P.M. Feb. 19
CARDBOARD RING
CARDBOARD TUBE TO FIT FLASH LIGHT

By GAYLORD JOHNSON

For instance, Circle No. 2 shows the appearance of the Pleiades through an opera glass. To see where to look in the sky for the Pleiades, find No. 2 on the map. The constellation Taurus containing the Pleiades, is in view in the East in December and in the southern sky during January and February. In the same way, each of the seventeen numbered opera- or field-glass features shown in the small, circular maps can be found by the figures on one or more of the time-table charts.

When using the lantern, thrust your lighted flash light up through the handle tube and view the maps by the soft glow from within. Then, after finding the feature to be studied, study it in its small circular detail map until you are familiar with what you need to look for. Switch off the light and identify the features through the glass, consulting the detail map again when necessary.

While studying the detail maps, it is advisable to be sitting down comfortably, meanwhile holding the lantern by its handle tube and turning the flash light on and off with your left hand. The opera or field glass, held in your right hand, can then be steadied upon the top of a photographic tripod. You will find the tripod a big help, particularly in using a field glass of six powers or more. The greater the magnification, the harder it is to hold the glass steady in observing fine details.

When the time-table for your three-months tour of the winter sky is complete you can set off without delay. You receive this magazine in early December. The time-table can be used from December 7 to February 20. The following numbered paragraphs describe the numbered detail maps and in each case the time when the feature can best be observed is noted in the description.

1. ALGOL, famous variable star: You will find Algol in the constellation Perseus, high up in the eastern sky in December; and near the zenith of *(Continued on page 89)*

NEW TESTS

Reveal Ancient Forgeries

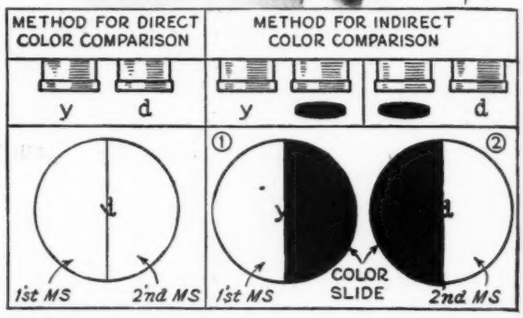
ANCIENT forgers of "rare" manuscripts, clever and ingenious as they were, are no match for scientific tests now used in the Huntington Library, San Marino, Calif., to detect literary fraud. No matter how convincingly the faker imitated the writing of a famous author, his work is quickly exposed by powerful microscopes, ultra-violet lights, and other scientific aids employed by the modern manuscript detective.

The forger always exercised great care in selecting an ink he believed to be the same color as that used by the original author. He did not know that microscopes available today would disclose the slightest differences in color. The modern investigator works in a little black, hooded cabinet, covered in front by a paper filter curtain. Under a microscope in this filtered "north" light, differences in color between original and spurious writing become strikingly apparent.

Sometimes a forger attempted to give his fraudulent manuscript the appearance of great age by using an old parchment whose original writing had faded. With the aid of filtered rays from a powerful lamp and a high-powered compound microscope, the manuscript detective can actually look through the superimposed writing and read the more ancient script.

Pencil forgeries are easily detected by a similar application of light. The lamp used for this purpose is built directly into the barrel of the microscope. An investigator, using adjustable controls, directs the light obliquely downward upon the suspected writing. By means of a rheostat, he regulates the intensity of light until the pencil marks cast just the shadow he desires. When the lighting is right, the minute streaks of both the original and fraudulent pencil marks are seen clearly by their shadows.

In another test a curious reading glass is used. This is fitted with a glass disk beneath the magnifying lens. The disk bears an incredibly fine pattern of hair-line blocks and circles, and with this pattern the investigator can measure precisely the size of written characters and the word spacing.



At top, experts matching ink colors of two documents. To do this, they are brought together under a twin-lensed microscope so the colors can be compared directly. This process is made perfectly clear in the diagram that is shown above

In this instrument, an oblique beam of light reveals which of two crossing pencil marks is the newer. The layers of the marks are thrown into relief and the more recent ones are seen to cross the others unbroken. The diagram shows such marks as enlarged about seven diameters

Circles and cross lines are ruled on a powerful magnifying glass, so fine they do not show in the photograph. With them, it is possible to determine the relative height of the letters

A binocular microscope is used to decipher faint writing that has been covered over with other writing. The use of twin lenses gives a stereoscopic effect that shows which is the more recent work

When writing is so faded that it is invisible, the ultra-violet cabinet is used to bring it into view. Chemicals in the faded ink glow, as shown, so the writing can be read. Sometimes, as seen in the diagram, the vellum itself glows and then the letters are dark against the background

Collecting Butterflies

THRILLING HOME HOBBY

Above, two examples of the beautiful creatures that are captured by moth and butterfly enthusiasts and mounted for exhibition purposes or for exchange

Above, a captured butterfly is seized with tweezers and placed in a cyanide box where the fumes kill it. Right, preparing a dead butterfly by placing it on its back and carefully stretching out the wings

By ALBERT CARTER

HIGH among the ash and laurel of the Rocky Mountains an enthusiastic young collector seeks out the giant Two-tailed Swallowtail, whose five-inch wing spread gives him the heavyweight title among North American butterflies. Down on the Texas plains another naturalist nets a tiny Pigmy Blue, whose wings stretch no more than three eighths of an inch from tip to tip.

Deep in a Guatemalan forest a third collector captures an exotic Owl butterfly, whose underwings contain owlish eyes. On a lifeless tree in India another gathers into his green net a Snake's Head moth whose outer wing tips bear striking resemblance to snakes' heads.

From plains, forests, and mountains the world over rare and beautiful butterflies and their night-flying relative, the moth, find their way into American collections. Capturing and raising them has become a large industry. The hobby belongs to amateurs, of whom there are tens of thousands, for it requires only a little skill, a very small investment, and a desire to seek out one of the most beautiful creatures ever evolved by nature.

You may adopt this hobby by simply deciding to do so. Years ago I raised butterflies on a screened porch. Then my collection began to grow. I moved it to a canyon in the hills near Roscoe, Calif., built a log cabin and screened in a large area. During the last eight years I have captured thousands of the little creatures, received some 60,000 from other collectors and have today many thousand specimens in my cases. From my long experience I have learned many secrets which will guide you into easier methods of capturing, growing, and preparing your specimens.

The average devotee of this

After a butterfly has been carefully prepared and dried, it is placed against a white background and covered with glass

To secure a moth cocoon, place a cloth cylinder over a plant on which a moth is feeding, as is illustrated below

Your butterfly or moth should be killed by placing it in a cyanide jar. Don't breathe fumes

sport is more interested in acquiring a personal collection of rare and beautiful specimens than in gathering them for sale. Butterflies, however, do have a definite value and prices range from one half cent up according to scarcity and demand. The pearly white Morpho zephyritis, a very rare butterfly of Changhamyo, Peru, is worth $45 a pair, while the black and white Ornithoptera victoria regis, or bird wing, of New Guinea has brought $250. The female measures seven inches across the wings and is one of the largest known.

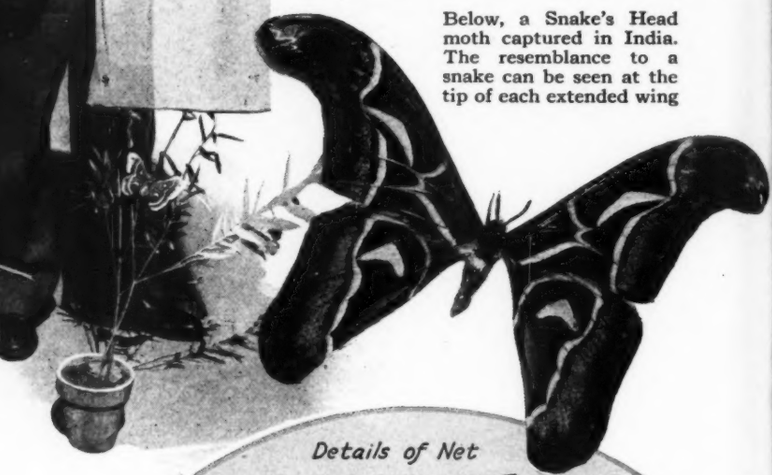
There are over 1,800 varieties on the North American continent, and amateurs sometimes add to these by discovering new types. Of the known forms, the Painted Lady and the Monarch are the most widespread. Most common butterflies may easily be captured. Rare varieties will lead you on exciting jaunts into out-of-the-way places, but butterflies by the hundreds may be raised with such simple equipment as a few yards of cheesecloth and a box with two sides knocked off.

Raising butterflies in captivity is an excellent way to obtain fine specimens. All butterflies and moths pass through four successive life stages—egg, caterpillar, pupa (chrysalis or cocoon), and adult insect. You will have no trouble in propagating them from any of the earlier stages, including the egg itself.

Butterflies lay their eggs upon the plant on which the caterpillar feeds. Watch a female that is hovering about a plant or tree, and settling occasionally upon a leaf. When she has flown away you are likely to find an egg securely attached to the top or under side of the leaf or to the twig itself; perhaps alone, or sometimes in a cluster of more than 100. The Vanessa antiopa, one of the first butterflies of the year, lays its eggs in early spring around a willow trig near the tip, usually surrounding the twig entirely for an inch or so. Later when the leaves are larger, it lays eggs in clusters, as many as 125 at a time, upon a single leaf. Some butterflies lay only one egg upon a leaf and others lay many, but they always lay them on the same side of the leaf and also in the same general position.

Eggs are hardest to find where there are many of the food plants growing closely together. It is often easier to discover eggs and caterpillars in the city,

Below, a Snake's Head moth captured in India. The resemblance to a snake can be seen at the tip of each extended wing



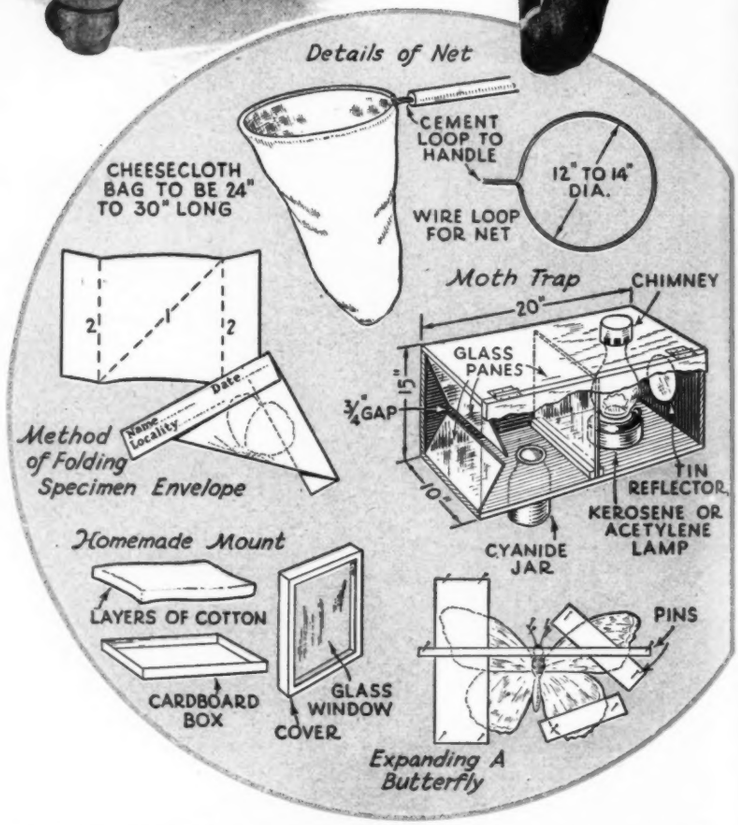
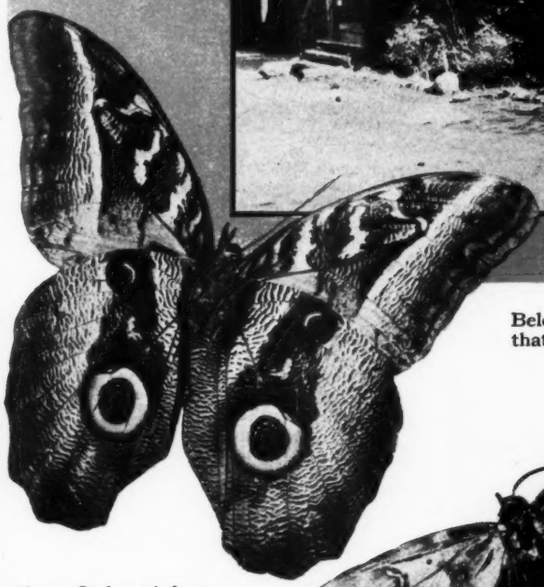


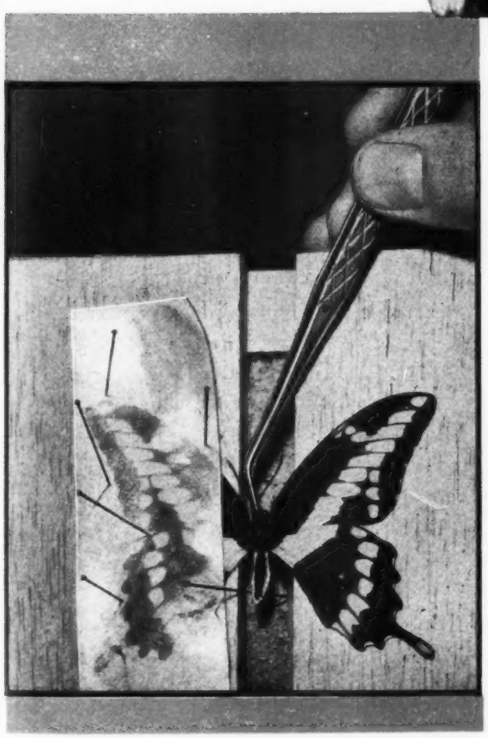
Illustration showing how to build butterfly net, trap for moths, and case in which specimens are mounted. Manner of spreading specimen is also shown

Right, view of author's butterfly farm at Roscoe, Calif. On it are over 50,000 specimens gathered from all parts of the world. Many other specimens are hatched and grown in cage on this farm



Above, Owl moth from India. Turn page upside down and the resemblance to an owl will be clearly seen

Below, Darling underwing moth that is found in United States



In preparing your specimen for exhibition, it can be mounted on a grooved board as is shown above

where the food plants are fewer, than in the country. Plants in yards and vacant lots or along curbings, in cities and towns, make good hunting grounds.

You will not have to look afield for eggs, however, if you catch the female butterfly with a net and place her in a cage with a food plant appropriate for that species. The cage may be made of two hoops and three laths, joined to make a barrel-shaped framework and covered with cheesecloth, with the bottom left open. Food plants may be planted in one or five-gallon tin cans and placed in this cage, together with a bouquet of fresh flowers. The cage, containing the imprisoned female, is then pressed into the ground to keep it from blowing over, the ends of the laths being sharpened for this purpose. After two or three days, many eggs should have appeared, if the butterfly is one of the many species that will lay them in captivity. Since they have been protected from the start, all eventually should become perfect butterflies.

Now you are ready to raise caterpillars from the eggs. The leaf bearing the egg can be removed and placed on a similar plant that is enclosed with cheesecloth. You will have better success, however, by leaving the branch with the deposited eggs undisturbed, until the caterpillars have hatched out and fed for several days, meanwhile keeping a cheesecloth cylinder tied over the branch. If the plant is large enough to furnish plenty of food, they can safely be left upon it, carefully covered with cheesecloth, until almost full grown. It will be convenient to fold cheesecloth into one long roll, several yards at a time, and sew it together to make a tube. It is then cut in lengths of one foot to three feet and slipped over the plants the caterpillars are feeding on, with one end tightly tied around the plant on each side of the caterpillars. Move the tube from time to time as they eat the leaves.

Meanwhile prepare an empty box by knocking out two sides and covering them with cheesecloth. When the caterpillars are nearly full-grown, they may be transferred to this box. Keep a fresh, unwilted supply of the food plant available for them, in generous quantities, by breaking off branches and putting them in a can of water like a bouquet of flowers. Be sure the caterpillars are enclosed in cheesecloth or similar material at all times to protect them from the tiny fly that lays its eggs in the live caterpillar, eventually killing it. If all these precautions are carefully observed, the full-grown caterpillars will soon attach themselves to the top of the box, where they will change into the chrysalis state and come out a few days later as butterflies. When the butterfly is a day old, and before it has a chance to lose any of its beauty, place it in the killing jar, the construction and use of which is explained later in this article.

Of course you can start with the caterpillars themselves, instead of the eggs, and raise them according to the methods just described. It is also possible to raise the caterpillars in a box from the start, but the foregoing method has much to recommend it.

Hunting the chrysalids of butterflies, and the cocoons of moths, provides you

This moth trap, consisting of cyanide jar, funnel, and light, will capture and kill countless moths while you sleep if it is properly placed under a thick growth of vegetation on which moths feed

with another way of obtaining specimens. Moth cocoons in particular are easy to find during the winter, for the large size of many of them makes them conspicuous among the bare twigs to which they are attached. Chrysalids or cocoons may be placed in a screened box and sprinkled occasionally with a few drops of water until they hatch. To obtain moth eggs, put the males and females together in a box covered with cheesecloth or window screen, as soon as they have come out of the cocoons and their wings are dry and ready for flight. Leave them together for a day or so, and then remove the male. Most moths will lay their eggs on the screen or walls of the box, or on twigs of their food plant if it is placed in the box.

The eggs may be removed in a day or two, folded into a leaf on the growing food plant which is pinned together to keep them from falling out, and the whole covered with a cheesecloth cylinder to protect them from ants and other enemies. Watch them occasionally to see that they have a plentiful supply of green leaves, moving them to another branch as often as may be necessary. Some moths pull the edges of the leaf together and then spin their cocoon inside, others fasten it securely to a small limb of the tree where it swings all winter and in the colder climates is frozen many times before coming out in springtime.

Capturing full-grown specimens is the most exciting part of butterfly collecting, and many fine ones can be obtained in no other way. A net is an absolute necessity in collecting many kinds of butterflies, but you can catch just as many with a homemade net as with one costing several dollars. All you need is some stiff wire, a yard or so of net or ordinary cheesecloth, and an old broom handle. First, bend your wire to a circle twelve or fourteen inches in diameter, then bore a hole in the end of an old broomstick and insert the twisted ends of the wire. The wire may be fastened in the handle by first filling the hole with a mixture of sawdust and glue, then inserting the wire and allowing it to harden before using. It may be fastened by pouring melted lead in the hole around the twisted ends of the wire or plaster of Paris may be used. The end of the handle should then be closely wrapped with strong twine, painted over with glue, and allowed to harden.

Next, make the bag twenty-four to thirty inches long, and sew the open end onto the wire frame. Some prefer to make the bag smaller towards the bottom as it is a little easier to take out the specimen when it is caught.

To catch a butterfly in flight, sweep it in with the open mouth of the net and then quickly turn over the hoop by twisting the handle, so that the butterfly is tripped in the folded-over end. A butterfly that has alighted near the ground may be caught by clapping the net down over it. Then, while the hoop is resting on the ground, the loose end is lifted with one hand. Most butterflies will fly upward into the end of the net, which may then be grasped and closed below it.

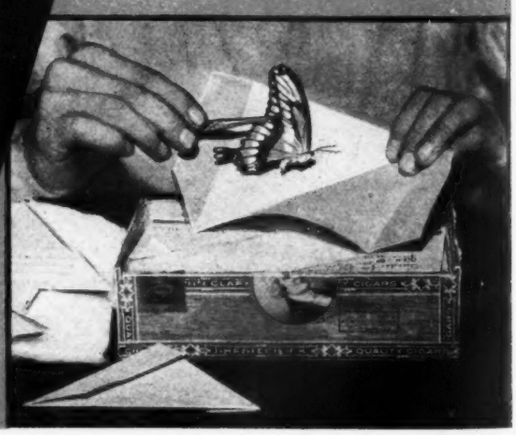
The best and most widely used method of killing butterflies is with the cyanide jar, which is made as follows: Take an ordinary glass fruit jar with a tight-fitting screw top. Put in the bottom of the jar an ounce or two of pure cyanide of potassium or sodium in lumps or crystals. (The cyanides of potassium and sodium are deadly poisons). Mix plaster of Paris with water until it becomes a paste and pour it over the cyanide, covering it completely with the plaster. Let the plaster harden. When it has set solid, cut two or three pieces of blotting paper to fit the jar, and place them down over the plaster to keep the specimen from becoming soiled. Cyanide is a very deadly poison and should be used with care.

A butterfly may be killed by removing the cover of the jar and inserting it in the net or breeding-box, holding it beneath the specimen. Stupefied by the deadly fumes, the butterfly will quickly fall into the jar, which is then closed to allow the lethal vapor to finish its work. After a short time the dead specimen may be removed to be pinned in a collection box, if the collector is afield, or mounted immediately.

Many beautiful and valuable moths can be captured at night while you sleep. Lloyd Martin, a *(Continued on page 112)*

At top, leaf bearing clusters of eggs laid by female butterfly. Center, a specimen of Dead Leaf butterfly from India. Above, lantern-chimney cage used in hatching out caterpillars

When shipping specimens place them in folded envelopes and then pack them in cotton in a cigar box, as shown below

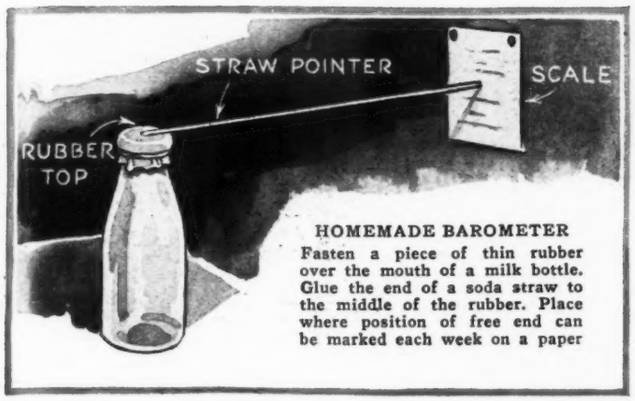


MAGIC OF SCIENCE IN

Easy Home Tricks

With These Simple, Everyday Things You Can Entertain All Your Friends

MAKING WATER SHOOT THE CHUTES. Place a piece of camphor on the bottom of an inverted saucer and ignite it. Smoke one side of a long piece of wrapping paper in the fumes and turn up the edges to form a shoot-the-chutes, smoked side up. Drop water on the top and the drops will run down the incline and jump over the gap



HOMEMADE BAROMETER
Fasten a piece of thin rubber over the mouth of a milk bottle. Glue the end of a soda straw to the middle of the rubber. Place where position of free end can be marked each week on a paper

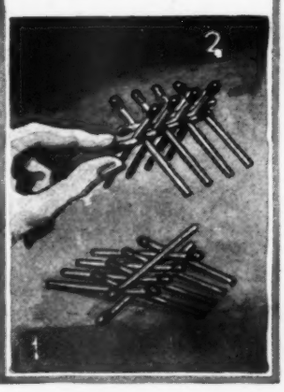
CAMPHOR MAKES BOATS SAIL
Make two paper boats about an inch long and cut a slot and pocket at the stern of each as shown below. Put a piece of camphor in each pocket and float the boats in a pan of cold water. They will sail around for a long time. When they stop, empty the pail and fill it with fresh cold water. Float the boats and they will start sailing again

A COIN AND BOTTLE TRICK
Place a coin on a card resting on the mouth of a milk bottle. Flick the card horizontally and it will fly out from under the coin, which will drop into the mouth of the bottle

CRAZY PHONOGRAPH RECORD. Make an off-center hole in an old phonograph record. Put the record on the phonograph turntable and play it, using this hole. You can have fun by letting your friends guess what the tune is

NOW YOU CAN DRINK AND NOW YOU CAN'T
You can mystify your friends with this simple trick. First have them drink water from a bottle through a tube as at the left. Then fill the bottle *full* of water and close it with a one-hole stopper through which the tube passes. They cannot drink from this bottle, because the drawing of water would produce a vacuum

LIFTING MANY MATCHES WITH ONE
Challenge your friends to see how many matches they can lift with one match. By piling the matches as shown (1) and holding one of them with thumb and finger (2), you can win the test easily



SAXOPHONE ROM SODA STRAW
Flatten the end of a soda straw for about an inch and trim off the corners as shown above. Put the end *into* your mouth and blow. With a little practice you can make a saxophonelike tone. With finger holes at intervals of an inch, you can play tunes

Things to Make in

Products of Industrial Chemistry May Be Reproduced by the Amateur, Supplying Useful Things at Low Cost

Collapsible tin tubes are handy for packing materials made in the amateur's laboratory

By RAYMOND B. WAILES

MONEY-SAVING, instructive experiments await the home chemist who turns amateur manufacturer. With his meager supply of beakers and bottles, he can make many valuable everyday substances that will reveal the mysteries of industrial chemistry.

It is perfectly possible, for instance, for the amateur experimenter to make his own writing ink. With very little trouble he can compound a so-called "standard ink," simply by using the following government formula as a guide: Tannic acid (eleven and seven-tenths grams), gallic acid (three and eight-tenths grams), ferrous sulphate (fifteen grams), hydrochloric acid (three cubic centimeters), carbolic acid (one gram), water-soluble blue dye (three and five-tenths grams), and 1,000 cubic centimeters of water.

The ferrous sulphate in this formula is our old friend iron sulphate, or copperas. If hydrochloric acid is not handy, muriatic acid can be used in its place, or sulphuric acid (two cubic centimeters) can be substituted. The tannic and gallic acids, strange as it may seem, are crystals. For the carbolic acid, the amateur will do best to have his corner drug store make up a solution containing five or ten centimeters of water, the entire amount being substituted for the one gram called for in the formula. The blue dye should be water-soluble, china-blue aniline dye. Methylene blue dye cannot be used as it causes a troublesome precipitation when the ink is made.

Although best results will be obtained if a small photographic balance is used to weigh out the chemicals, the experimenter lacking this piece of equipment can approximate the weights by allowing one teaspoonful for each five grams of any chemical. For the liquid measure, an ordinary eight-ounce drinking glass can be considered as holding about 240 cubic centimeters.

In following the formula, first dissolve the tannic and gallic acid crystals in about 400 cubic centimeters of water. In another beaker, containing 200 cubic cen-

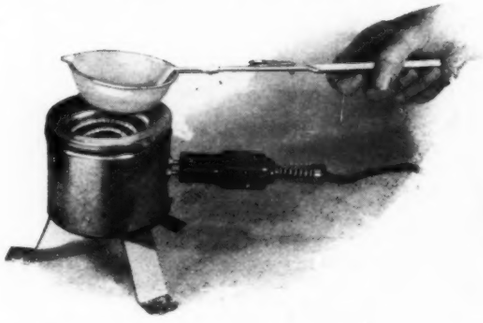
Easily Made Electric Heater for Crucibles

FEW materials are needed to construct the handy electric crucible or evaporating-dish heater illustrated. A tin can, a heating element, some wire, two connecting lugs, and some furnace cement complete the list.

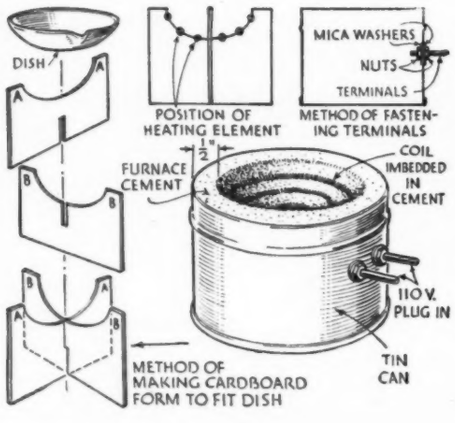
Any shallow tin can having a large diameter can be used as the main container. The connecting lugs, obtainable from your neighborhood electrician or supply store, are the type used on electric irons and large heaters. The electric heating wire can either be bought or salvaged from a discarded 110-volt room heater or other appliance.

The heating element first is wound, spiral fashion, on a form made by slitting a cross-shaped assembly of stiff cardboard. The ends of the heating element are in turn connected to the inside ends of the plug terminals soldered in holes punched in the can. Then, with the heating element and its form in place inside the can, furnace cement is tamped in until it comes within a quarter inch or so of the heating element. After this layer of cement has been allowed to dry, more cement is applied and the finishing touches put on.

Finally, after a thorough drying, the heater is ready for use. If any cracks should form during the drying process, the surface should be wetted and patched with a new batch of the furnace cement. Legs, cut from sheet iron, can be soldered to the bottom of the can as a finishing touch. If your laboratory lacks a pair of crucible tongs, a good substitute is available at most five- and ten-cent stores in the form of long-nosed pliers.



Placing the heating element in the tin can. Upper right, the finished heater in use. The tongs are ten-cent pliers



Your Home Laboratory

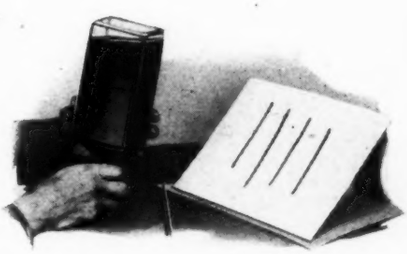
timeters of water, place the ferrous sulphate and the hydrochloric or sulphuric acid. The dye then should be dissolved in 200 cubic centimeters of water placed in a third container. When all three solutions are ready, mix them together and add the carbolic acid solution and enough additional water to bring the total solution up to about 1,000 cubic centimeters in volume. A part of this water can be used to rinse out the containers.

Pour the resulting ink into a bottle, leaving practically no air space at the top, and stopper it tightly. The ink is then ready for aging, a process that may vary from twelve hours to several weeks. The longer the ink ages, the freer it will be of suspended particles.

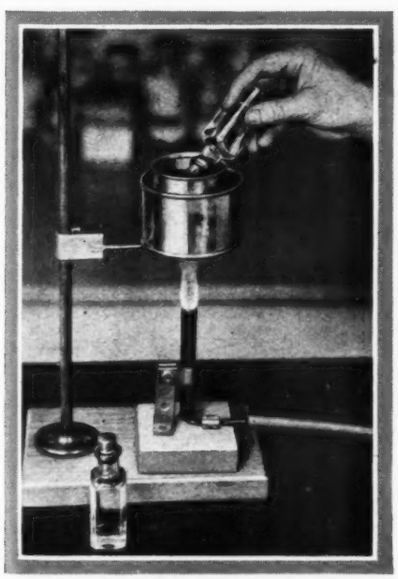
IF YOU have followed the instructions carefully, your completed solution will be a good grade of ink, known to industrial chemists as blue-black iron gallo-tannic ink. The chemistry of this ink is easily understood. First of all, the ferrous sulphate combines to form iron tannate and iron gallate when it comes in contact with the solution of tannic and gallic acids. When exposed to the air for some time, these substances turn black and are responsible for the black color the ink assumes after it has dried. The original blue color obtained when the ink flows from your pen comes from the blue dye. If a dye were not used, the writing would not be visible for several days until the iron compounds turned black. The hydrochloric or sulphuric acid serves to prevent the ink from forming a sediment, while the carbolic acid acts as a preservative to prevent mold.

Inks of other colors can be made by using different dyes. Violet, for instance, can be made by using methyl violet dye while black can be had by employing soluble nigrosine dye. Incidentally, nigrosine dye yields a legible ink when merely dissolved in water, but the resulting solution can hardly be classed as a permanent ink.

In making ink and other things, a small balance is needed for weighing the chemicals. Papers are placed on both scales, and the material to be weighed is then conveyed to the pan upon a spatula. If a balance is not available, weights can be roughly gauged by measuring in a teaspoon



A good ink will show no sediment after standing for twenty-four hours. Tests for fluidity and opaqueness are also made easily



Skin-tight cappings may be placed on bottles by dipping the corked necks into a hot mixture of cooking gelatin, glycerin, and water

Although not exactly part of the ink manufacturing process, the standard tests used to determine the quality of ink form interesting experiments for the amateur ink maker. One simple yardstick of quality is known as the spreading or fluidity test. This is accomplished by allowing a definite volume of the ink, about five or six drops, to fall on a sheet of paper resting on a piece of glass inclined at forty-five degrees. The ink being tested should show approximately the same tendency to spread as other inks. Be sure, however, to use the same volume of each ink.

After a week or so of aging, homemade ink can be subjected to the opaqueness test to determine its blackness by comparing the various streaks obtained in the fluidity test. Also, by soaking the paper containing the streaks of ink in water, or a fifty-percent solution of denatured alcohol, for about twenty-four hours, some idea of the comparative weathering and washability characteristics of the inks used can be obtained.

Once the theory of an iron ink is understood it is a simple matter to grasp the action of ink removers or eradicators. Most two-solution ink eradicators consist of a solution of bleaching powder in water and one of oxalic acid. In use, the bleaching powder solution is first daubed on the ink spot, allowed to remain a minute, and the surplus blotted off. Then, the oxalic acid solution is applied. The action of the two solutions is first to bleach the dye used in the ink and then to dissolve the iron compound. Another method of eradicating ink consists of soaking the spot with a one-percent solution of potassium permanganate and then following with sodium thiosulphate or "hypo" solution until the ink is colorless.

BY MIXING cream of tartar (potassium bitartrate) and potassium binoxalate to a paste, the home chemist can provide himself with an excellent remover of rust spots. Simply wet the fabric in the area of the spot and apply the paste. Soon the brown rust stain will become colorless and at this point the cloth should be rinsed in water. In using these chemicals, the amateur should remember that both binoxalates and oxalates are poisonous.

Even the manufacture of a good metal polish is entirely within the scope of the home laboratory. All that is required is some whiting, precipitated chalk, crocus martis (finely divided iron oxide), and ortho-dichlorbenzine. Mix the first three in equal quantities and then wet them with the ortho-dichlorbenzine. This will form a paste polish. If a liquid polish is desired, mix ortho-dichlorbenzine with an equal volume of oleic acid. Both polishes should be *(Continued on page 104)*

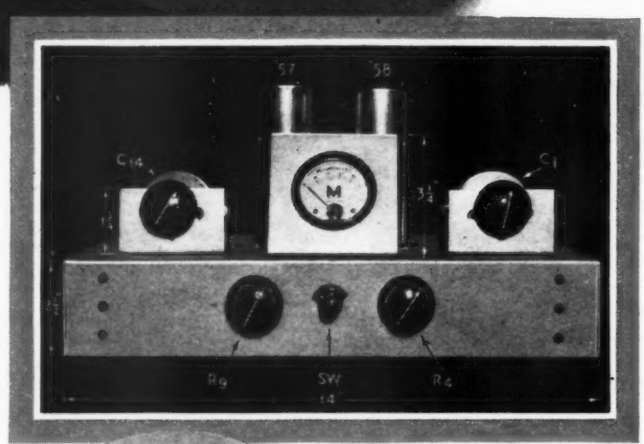
GET YOUR VOICE ON THE AIR WITH THIS Amateur

Below, a 160-meter radio telephone that can be assembled complete for $40. It uses receiver parts entirely

IF THE high cost of transmitters has kept you from owning your own short-wave station, here is your chance to build a first-class 160-meter radiotelephone for little more than the price of a good receiver. From the chassis up, this circuit has been designed for the beginner. Every drawback of the usual transmitter has been eliminated by careful planning. First of all, it is made up almost entirely of standard receiver parts which are both inexpensive and easily obtained. Second, it requires no complicated antenna system. And third, it is easy to adjust and simple to operate.

As the diagrams show, the transmitter makes use of four common types of receiver tubes. A type '56 serves as the crystal-controlled oscillator, a type '58 forms the buffer amplifier, and a pair of 2A5's in parallel act as the final stage. With the modern form of grid modulation employed, a single type '57 resistance-coupled amplifier provides adequate speech amplification for the single-button microphone used. The crystal in the oscillator is of the "Y" cut variety since it is substantially cheaper than the "X" cut and in this circuit gives equally good results.

With the exception of the power supply and the special antenna coupling unit, which will be described later, the transmitter is assembled on a 2½-by-8-by-14-in. chassis bent from aluminum. How the parts are arranged for convenience in wiring is shown in the photographs.



How the various controls are mounted on the front of the chassis is shown in illustration above. Simple aluminum bracket holds the meter

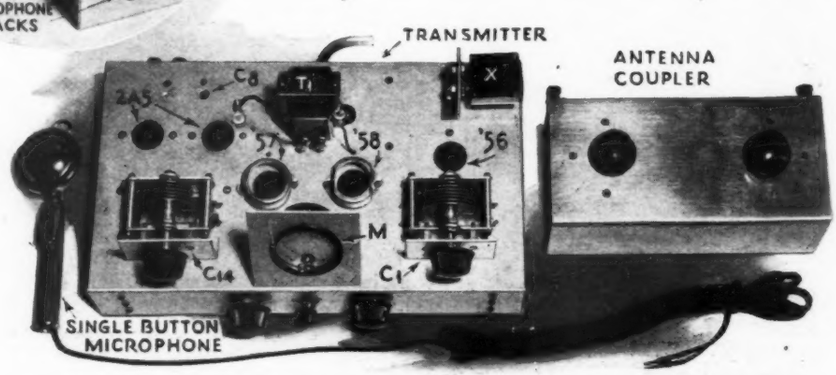
The oscillator circuit is crystal-controlled, the crystal being mounted in the usual holder supplied with plugs so it can be removed

Mounted on the front, are the radio-frequency and audio-frequency gain controls (R_4 and R_9) and the plate switch (Sw). On the top are two variable condensers, the 1,800-2,000-kilocycle crystal and its holder, the microphone transformer, the plate meter, and two tube shields. At the rear are two microphone jacks, the output binding posts, and the power supply cable.

In the two and one-half-inch space under the chassis are the various coils, tube sockets, fixed condensers, fixed resistors, chokes, microphone battery, and connecting wires. The fixed condensers and resistors are self-mounted by means of the soldered connections to their pigtail terminals.

Composition tubing, one inch in outside diameter, is used for the coil forms. Coil L_1 consists of eighty turns of No. 26 wire on a three-inch form, L_3 has seventy-five turns of No. 30 wire tapped at the fifteenth turn and wound on a two-and-one-quarter-inch form, while L_6 contains 100 turns of No. 22 wire center-tapped and wound on a four-inch form. In each case, the wire should be double silk covered (DSC). It is not necessary to shield the coils, but they should be mounted at right angles to each other. Obviously, since L_3 is the shortest unit, it should be mounted with its axis vertical. L_1 then can be placed horizontal and parallel to the side and L_6 can be mounted horizontal and parallel to the front edge of the chassis. To provide rigid mountings, the coils should be held in place with small metal angle brackets bolted to the chassis.

An important supplementary unit of the transmitter is the simple antenna coupler consisting of two .0005-mfd. variable condensers (C_{16} and C_{17}) and an inductance or



By means of an antenna coupler, the need for a special antenna for this transmitter is eliminated

Phone Transmitter

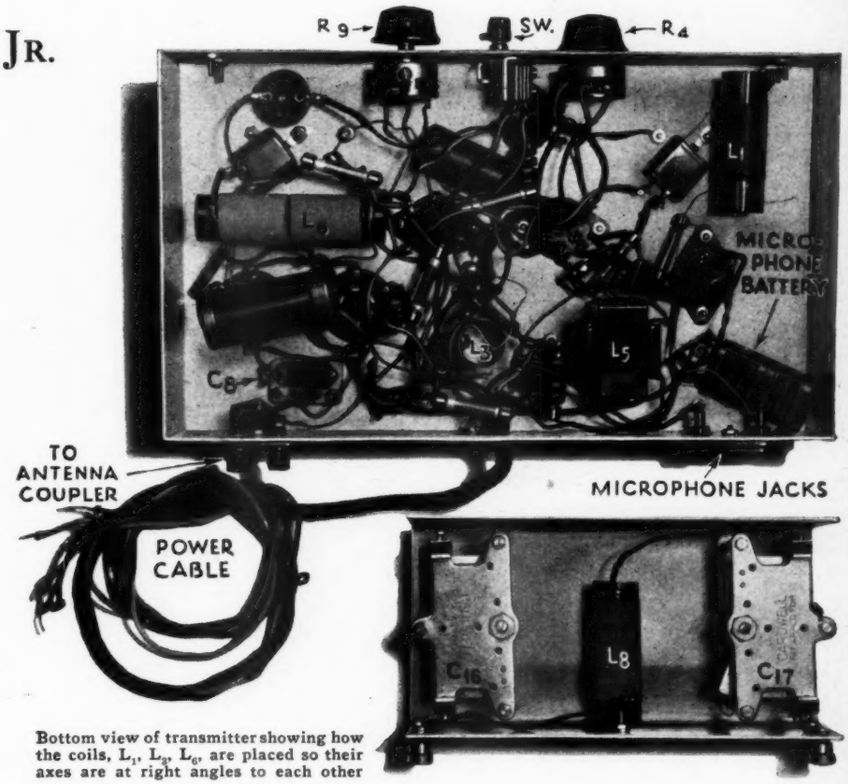
By J. A. WORCESTER, JR.

coil (L_8) made up of seventy-two turns of No. 22 DSC wire wound on a form one inch in diameter and three inches long. These units are mounted in a small 3-by-4½-by-8½-in. aluminum chassis furnished with two input binding posts and two output terminals (antenna and ground).

The purpose of the coupler is to provide a satisfactory connection or impedance-match between the transmitter's final amplifier and the antenna, thus eliminating the necessity of using a special antenna and complicated feeders or lead-ins. With it, any length of antenna, even a regular broadcast antenna, between twenty and sixty feet long can be used. It must be remembered, however, that it is always preferable to use a long, high wire, substantially clear of surrounding objects and having a lead-in that is short and direct.

If for any reason, you cannot rig a good single wire antenna, a doublet antenna with twisted or transposed feeders can be used. In this case, of course, the ground connection is replaced by the second lead-in.

For the power circuit, almost any well-filtered broadcast power supply capable of furnishing at least 250 volts can be used. If one is not available, the amateur can construct a suitable unit for about six dollars. The supply shown, having a maximum output of 250 volts, which will give the transmitter a power output of approximately seven watts, is made up largely of receiver parts such as the amateur may have on hand. The transformer, for instance, is of the common variety used in modern broadcast sets,



Bottom view of transmitter showing how the coils, L_1, L_3, L_6, are placed so their axes are at right angles to each other

supplying 700 volts center-tapped at 100 milliamperes, five volts at two amperes for the '80 rectifier tube, and two and one half volts at eight amperes for the parallel-connected heaters of the tubes in the transmitter circuit.

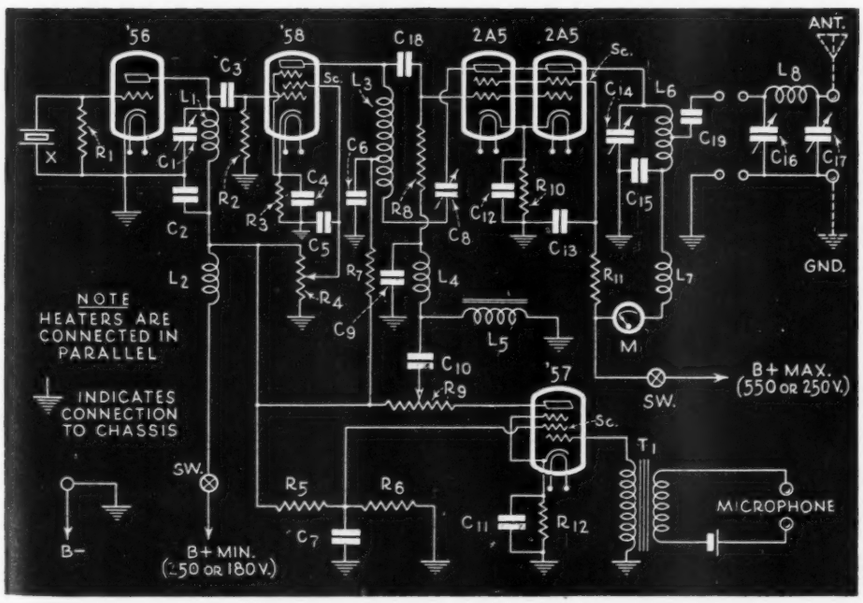
Likewise, the chokes are of the readily obtained broadcast receiver type while the filter condensers are of the dry electrolytic variety available in a single compact container. The parts can be mounted on a 2½-by-8-by-12-in. aluminum chassis.

In adjusting the transmitter, the amateur will have little difficulty if he follows a definite procedure:

The first problem is to neutralize the final amplifier. To do this, remove the crystal temporarily and connect an ordinary twenty-five-watt electric light bulb across the output terminals of the final amplifier. The power supply then should be turned on and the condenser C_{14} rotated. If the bulb glows at any setting of this condenser, or if the needle on the plate meter (M) jumps, it is an indication that the final amplifier is oscillating. Condenser C_8 then should be adjusted slowly with a screw driver until there is no motion of the meter needle during a complete revolution of condenser C_{14}. It will then be neutralized.

When the final amplifier has been adjusted, replace the crystal in its mounting and set the radio-frequency gain control (R_4) at its maximum. Also, remove the electric light bulb from the output terminals and turn the condenser C_1 to minimum capacity. Rotating condenser C_{14} then should produce a pronounced drop in the plate meter reading, indicating the point at which the tank circuit is in resonance with the frequency of the oscillator. If this condition is not obtained, condenser C_1 should be turned in small steps until it is obtained.

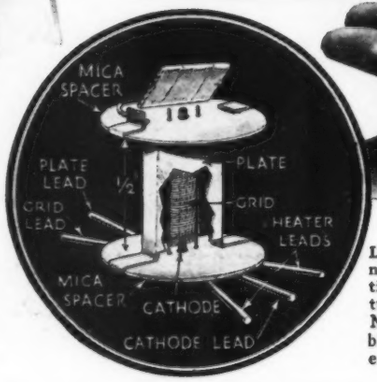
The an- *(Continued on page 106)*



New Dwarf Tube

READY FOR AMATEUR

At right above is a large transmitting tube. Compare it with the tiny new tube which the young woman is holding. This is the smallest tube made but like other tubes it can be used for transmitting or receiving



Left, the internal construction of the new tube is shown. Note its resemblance to heater-type tubes

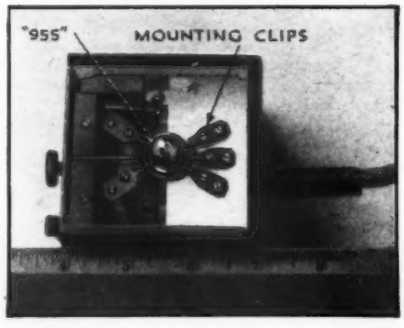
Upper left, close-up of the new midget tube showing approximately its actual size. Above, the tiny tube and an acorn. Note the remarkable resemblance that gives tube its name

ONLY slightly larger than an acorn, and resembling it in shape, a radically new tube is now available to the amateur. Designed for use on the ultra-short waves between one-half and five meters, it opens a new field for experimenters in micro-wave reception and transmission.

Measuring less than an inch and a half in height, it more than justifies its title of "the world's tiniest practical radio tube." Yet inside its miniature acorn-shaped globe are a plate, grid, cathode, and heater that resemble the conventional elements in a full-sized three-electrode, heater-type tube such as the common '27 or '37. These elements terminate in five prongs radiating from the base of the acorn like the fingers on a hand.

Designated as the 955 by the RCA Radiotron engineers who developed it, the tube is a challenge to radio fans interested in portable receivers, transmitters, and transceivers covering the ultra-short bands (P.S.M., Dec. '33, p. 58). It can be used as an oscillator and an amplifier as well as a detector, and operates on a six and three-tenths-volt heater current, either A.C. or D.C. and 180-volt plate current. According to its designers, the tube is the only triode capable of operating efficiently at frequencies under 60,000 (five meters).

An ultra-short wave receiver employing these acorn tubes, resembles the ordinary short-wave receiver with the exception that a special so-called tuned dipole antenna is used. As shown by the diagram, it is simply a regenerative detector feeding into a conventional resistance-coupled amplifier. When assembled for test, the parts were arranged in a midget three-by six-inch cabinet with room to spare.

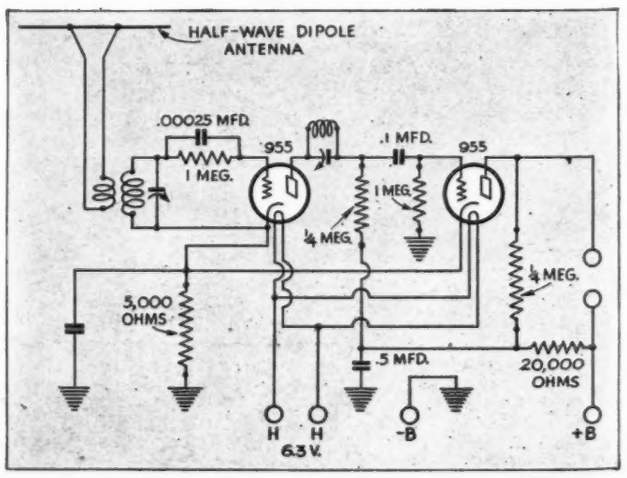


Above, tiny one-meter transmitter that uses the new tube. Note, ruler shows it is three inches wide

Although the 955 is not especially designed to be a transmitting tube, like the larger receiving tubes, it can be used in transmitters by amateurs. When used for this purpose, sufficient power output can be obtained to cover the line-of-sight distances usually associated with micro-wave transmissions. In the transmitter shown, it is used in a Hartley circuit for operation on the now popular one-meter band.

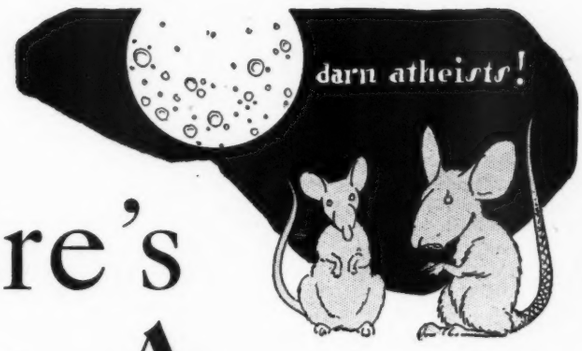
Because of its radical design, the 955 requires a special method of mounting. This is done by means of five spring clips supplied with the tube. The clips, arranged to coincide with the five terminals that sprout from the sides of the tube, can be fastened to a supporting insulator of glass, mica, or other low-loss material. A hole, of course, must be cut in the mounting to take the bulging bottom of the tube.

Although not intended as a replacement for the large tubes in regular receivers, it does offer the experimenter a new unit that should serve as the basis for many novel circuits that will tell us more about the mysteries and possibilities of the ultra-short waves.



Right, diagram shows simple regenerative detector and resistance-coupled amplifier circuit used in one-meter receiver described in text

Question: What is the moon made of? J. L., Dallas, Tex.



Here's *the* Answer

A.—ACCORDING to noted astronomers, who base their theory on tests made with an instrument called a moon thermometer, the moon consists chiefly of pumice or some similar porous substance.

Good for the Laundries

O. P. T., PHILADELPHIA, PA. It is estimated that 70,000,000 tons of soot drop on American cities every year. Besides staining buildings, linen, and streets, it cuts off more than thirty percent of the sunshine.

Hand Not A Foot As A Rule

Q.—WHAT is the standard "hand" measure used in measuring the height of a horse?—G. F., Sioux City, Iowa.

A.—THE "hand" used in measuring horses is equivalent to four inches. To say that a horse is seventeen hands high means that he stands sixty-eight inches from the ground to the withers or peak of the front shoulders.

Oiling the Waves

Q.—WHY does oil calm the sea?—F. G., Baltimore, Md.

A.—TWO properties of heavy oil are thought responsible for its calming effect on restless waters. It reduces the friction of the surface of the sea, making it easier for the wind to slip over the top, and its viscousness tends to hold the waves down and make them move more slowly.

Sometimes the Plot Helps

Q.—HOW do they create the effect of fog in the movies?—Y. P., Seattle, Wash.

A.—ONE simple method consists of spraying a stream of vaporized oil into the blast from a powerful motor-driven propeller. The propeller distributes the oil mist through the air and proper lighting makes it visible.

Chained Static

Q.—WHY is a gasoline truck invariably fitted with a short chain that hangs down from the rear and drags along the road?—G. T., Sioux City, Iowa.

A.—TIRES and other moving parts on a truck tend to generate static electricity. The short length of chain serves as a connection between the metal chassis and the ground to lead off any charge of static electricity that may develop and thus prevent it from accidentally causing a dangerous spark. If trucks used metal tires, the chain would not be necessary.

Keep It In The Dark

Q.—WHY do automobiles seem peppier and smoother-running at night?—D. J. B., Hollywood, Calif.

A.—ACCORDING to experiments made by automotive engineers, a slight amount of water injected into the combustion chamber of any gasoline motor tends to improve its operation. It is thought that the oxygen supplied by the water aids the combustion. At night, or during misty or foggy weather, a certain amount of moisture undoubtedly is drawn into the cylinders of an automobile with the gas.

Patching Camels

Q.—RECENTLY I read that camel's wounds never heal and that to cover the sore the animal's skin is patched with leather. Is that true?—C. W., Watertown, Wis.

A.—ACCORDING to various camel authorities, there is no truth in the familiar statement that a camel's wounds never heal. However, camels do develop foot sores that often are protected by sewing patches of leather to the pads on the bottom of the animal's feet. The leather serves more as a sole for a shoe than as a patch.

Thundering Echoes

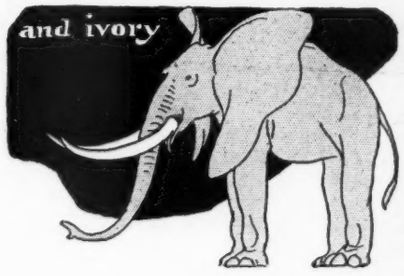
H. P. G., CHICAGO, ILL. The roar and rumble following a crash of thunder are echoes, sound waves reflected by the earth and clouds. A large shell or bomb, if exploded high enough in the air, would have the same effect. Sound waves travel 1,090 feet a second at a temperature of zero Fahrenheit.

Racing Neck and Neck

G. A. S., Jr., PORTO DE LIERRA, PORTO RICO. Radio waves are considered as having the same speed as light—approximately 186,271 miles a second.

Ink for Stencils

M. J. B., EAST ORANGE, N. J. To be suitable for use with stencils, an ink must be thick, more like a paste than a fluid. A satisfactory ink of this type can be made by mixing the following: Shellac (two ounces), borax (two ounces), water (twenty-five ounces), gum arabic (two ounces), and enough Ventian red, lamp black, or Prussian blue to give the desired color. Boil the shellac and the borax in some water to dissolve them. Then add the gum arabic, discontinue the heating, and when the solution has cooled add enough additional water and coloring to bring the ink to the right consistency.



A Question of Ears

H. K., BALDWIN, L. I., N. Y. One feature that distinguishes the Indian elephant from its African brother is the size of its ears. The African elephant's ears are large while those of the Indian variety are comparatively small. Also, the hind feet of the Asiatic variety usually have four toenails each while the African variety have but three.

Climate and Trees

Q.—HOW do scientists determine the past climate of a certain locality?—L. V., Richmond, Va.

A.—ONE way is by studying the annual rings in the trunks of old trees. The more rain during a certain year, the wider the ring of growth. In California, for example, many trees are more than 3,000 years old and by their rings much can be told of the climate in that vicinity during the time of Christ.

Why Leaves Turn

Q.—WHAT causes the leaves of a tree to turn red and brown in the autumn?—P. Z., Boston, Mass.

A.—CHEMISTRY plays a large part in the turning of the leaves when cold weather sets in. First of all, the original green color of leaves is due to a substance called chlorophyll. In the fall, lower temperatures and less sun cause this chlorophyll to change into a red-brown compound. *(Continued on page 90)*

Car's Rattles

FOUND BY TOUCH SYSTEM

Gus grasped the bumper and started shaking the car. "Listen," he said, and the clack-clack previously heard came from the springs

By MARTIN BUNN

"CONFOUND that noise," exclaimed the elderly Dr. Pearson as he thumped the steering wheel with his fist. His wife, seated beside him touched his arm soothingly. "Now don't get so excited, Frank," she said. "A few rattles aren't hurting anything. Most of it's your imagination anyway."

"Imagination be hanged," grumbled the doctor. "Sounds like the car is falling to pieces every time we hit a pebble, and that eternal popping noise in this door is driving me crazy." Just then Mrs. Pearson noticed a squat building further on down the street. Above it hung a large sign that read: "Model Garage—Auto Service and Repair."

"There's a nice-looking garage," she said. "Why don't you stop? Maybe they can locate the trouble. I'll do some shopping while you wait."

A few minutes later, Dr. Pearson was telling his tale of woe to a gray-haired mechanic who had introduced himself as Gus Wilson.

"Doesn't look like a rattle box," remarked Gus, eyeing the car. "But if it has 'em, we'll get rid of 'em. Start the motor for a minute."

"The motor's all right," protested Pearson, reaching for the ignition switch. "It's the body that's making the noise." When the motor settled to an even purr, Gus lifted the hood and moved his hand from one part to another. He seemed particularly interested in the cowl wall at the back of the engine block and ran the palm of his hand over the flat surface several times before he finally refastened the hood.

"O. K. Now if you've no objections, suppose we go for a little ride," he said, climbing into the seat beside the physician. "Let's go up the street for a few blocks and drive out the old station road. That'll be a good test."

As the car gained speed, a series of sharp raps or pops occurred each time the wheels hit any unevenness in the pavement. They were neither rattles nor squeaks, but more like creaks.

"There's that popping noise I told you about," the old man sputtered. "That racket keeps up indefinitely. Sounds as though it came from this side of the car, but I'll be hanged if I can find it."

Without answering, Gus moved his hand over the instrument panel, along the base of the driver's seat, and finally over the floor boards.

"It isn't the floor boards," said Dr. Pearson positively. "I've got them so tight now I'll need a crowbar to pry them loose."

By this time, the car was jouncing along the poorly paved road that led to the railroad station. Bouncing from bump to bump, it gave forth a new assortment of clattering noises that all but drowned out the doctor's booming voice.

"Just three things are making an anvil chorus out of this car," explained Gus after a thorough inspection of the car back at the Model Garage. "A loose radiator stay rod, tight floor boards combined with loose body bolts, and loose spring shackles.

Dr. Pearson looked at him blankly. "Now how in the world can a floor board make a noise when it's tight," he asked.

"Simple enough," answered Gus. "In the first place, the frame on any car weaves a bit when it's driven over an uneven road. If the body bolts are loose the body twists even more, pushing the floor boards with it. Naturally, if the boards are fastened tightly at both ends, they can't move, so they strain and twist. The result is that pop you've been hearing. Loosening one end of the floor-board section will fix it."

"But won't they rattle if they're loose?" asked the doctor.

"I won't loosen them that much," replied Gus. "Just enough to allow a little play at one end. Then I'll give the ledges they rest on a good dose of heavy oil and finish up by tightening the body bolts."

"Certainly sounded like a door rattle," Dr. Pearson insisted.

"That just proves you can do a sight more with touch than you can with your ears when it comes to tracing rattles and squeaks in a car," smiled Gus. "Car noises are funny things. They have a way of scooting through the frame or the body till they reach a broad surface that acts as a sounding board. Your ears will place the noise at the sounding board but your finger tips will trace it to the source. Just as an example, start up your motor and listen. Do you hear anything?"

"Yeah," the doctor agreed. "Sort of a rapid-fire rattle."

"Where does it sound like it's coming from," asked Gus.

The elderly physician scratched his head. "Sounds like the instrument panel to me," he ventured. *(Continued on page 103)*

GUS says:

If you hate the hard work of polishing or waxing your car, at least take the trouble to keep the hood in shape. Remember, it gets the brunt of the weather and a continuous baking from the heat of the motor. It doesn't take long for dirt and tar to bake on so hard that it takes more than just a casual rubbing to remove them. The sap that drops from trees also is particularly hard to remove once it is baked in place.

BRILLIANT "Stained Glass" Windows

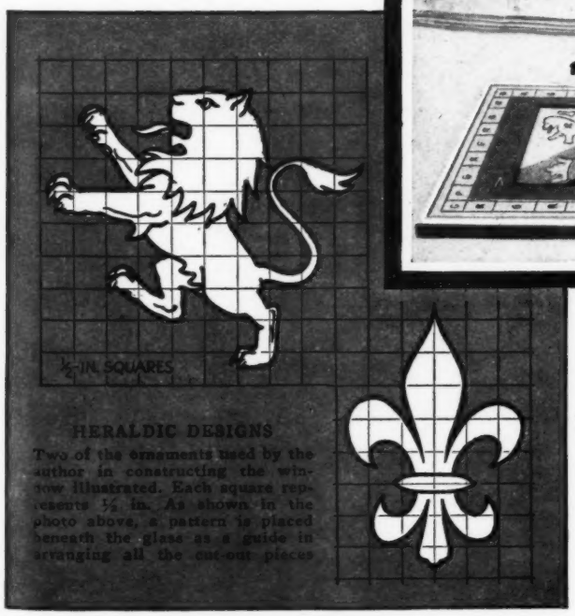
MADE WITH ONLY A PENKNIFE

By Eric Munsinger

WINDOWS that rival genuine stained glass in beauty can be made easily and inexpensively by using colored cellophane. The design is merely cut out with a sharp penknife and sandwiched between two pieces of translucent rippled glass.

The method is so simple that you can prepare any type of design you please and incorporate your monogram or any other emblem. Nevertheless, the finished effect is of extraordinary brilliance. It may even surpass windows made of separate pieces of colored glass in the ordinary way, in spite of their costly materials and the painstaking craftsmanship and long experience required in their construction.

The design is cut from sheets of colored cellophane and set between panes of translucent glass, rippled on the outside



HERALDIC DESIGNS

Two of the ornaments used by the author in constructing the window illustrated. Each square represents ½ in. As shown in the photo above, a pattern is placed beneath the glass as a guide in arranging all the cut-out pieces

There is something particularly clean-cut and modern about windows made in this way. They have the clear, unobstructed surfaces that are characteristic of modern furniture and buildings. If, however, an antique effect is desired, it is a simple matter to give the appearance of separate panes of leaded glass. This is done by using so-called "cold" or "liquid" solder to form lines in imitation of leading.

In addition to the window that will be described in detail, two supplementary designs without dimensions are shown in the drawings at the top of the following page. Most books on heraldry or stained glass contain illustrations and suggestions for various other designs. The reader, however, will probably prefer to use his initiative so far as to incorporate his initials or coat of arms into the pattern. Lodge, club, and school emblems also make excellent subjects.

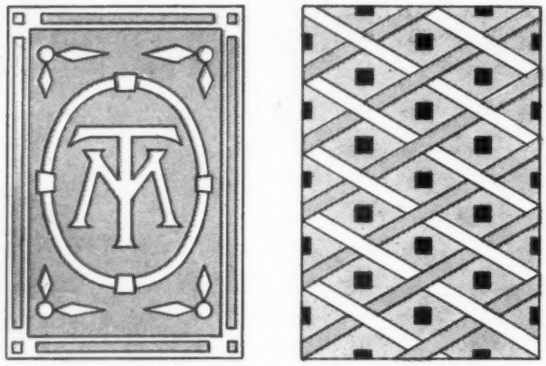
For the window made by the author, the following materials were used: Two sheets of translucent glass, 15 by 20 in., each having one smooth and one rippled surface. (These should be as thin as obtainable.) Four rolls of colored cellophane—red, purple, yellow, and green. A few large sheets of white bond paper;

UNIQUE NEW METHOD USES TRANSPARENT CUT-OUTS SANDWICHED BETWEEN PANES OF RIPPLED GLASS

a little transparent (liquid) glue, and some glass or celluloid cement.

Draw two copies of the design pattern actual size, preferably with India ink. Mark on each section of each design the color it is to be.

Lay a sheet of cardboard or several thicknesses of paper upon your drawing board or table, and place one sheet of each color of cellophane upon this. Now lay one of the patterns upon the whole, smooth it all out well so that there are absolutely no wrinkles in the cellophane, and fasten securely around the edge with thumb tacks.

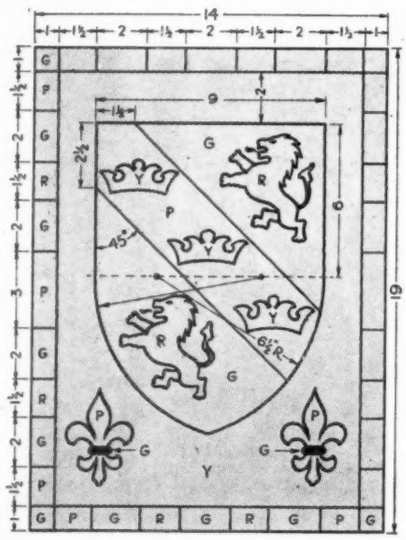


Suggestion for a monogrammed window that will give an individual touch to any entrance hall, and a pattern for blue and gold latticework with red squares on a green background

Using a small, very sharp penknife (or the corner of a razor blade), cut out all the different sections of the design. Set aside the pieces of the desired colors for each section, putting them separately between the pages of a book, and keep the border pieces in their correct order. The rest may be discarded. Cutting all colors at once in this manner facilitates the work and insures that the sections will fit together perfectly. The cutting should be begun from the center to avoid disarranging the different sheets, since they are fastened only at the border.

Next take the other pattern and put one sheet of glass, smooth side up, upon it. The design is, of course, clearly visible through the glass. Using it as a guide, fit the sections of cellophane in their places. Tack them down in a few spots along the edges with the transparent glue. Small tweezers will prevent finger marks on the cellophane and make the handling easier.

When the picture is complete, lay the



other sheet of glass on top, smooth side down, and cement the two around the edges to hold them firmly together and keep out moisture.

All colors are cut simultaneously so ... will be certain to fit. *At left:* Layou... the window described. The green parts marked G; purple, P; red, R, and yellow,

Those who desire to make a perfect replica of a genuine stained glass window may do so by applying liquid solder t... the outside surface in narrow lines, ... tween the different colors, to simu... leading. Although this may give the pane a more genuine appearance, the author believes it detracts from its beauty, since the original purpose of the lead was merely to fasten the separate pieces of glass together.

The "stained glass" is fitted into the window sash like any ordinary pane.

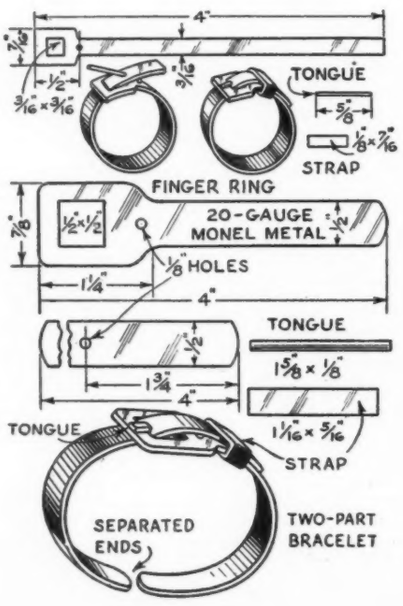
Handmade Rings and Bracelets Look Like Buckled Belts

BELT-BUCKLE rings and bracelets are a novel form of jewelry that can be made with very few tools by beginners in decorative metal work.

In making the ring, obtain a piece of 20-gauge monel metal and cut out the blank as shown. Drill a small hole, 1/16 in. in diameter or less, where indicated. Bend the metal in a circle, push the small end through the square hole, and adjust to the desired size by shaping over a ring mandrel or a tapering piece of round iron or wood. Drill a hole for the tongue of the buckle. Make the tongue from a piece of the same metal and bend one end at right angles, the bent portion being about 1/16 in. long.

Insert the straight end of the tongue through the hole in the belt; then stick the bent end into the hole drilled in the buckle. Place the ring on the mandrel and hammer the end of the belt into place. Place the strap, bent U-shaped, over both thicknesses of the belt, and with pliers clamp the ends on the inside of the ring. File off the tongue of the buckle to the proper length and polish the ring on a buffing wheel, using jeweler's rouge.

In making the bracelet, two strips of metal are used. Stick the end of the plain piece—the end nearest which the 1/8-in. hole has been drilled—through the buckle, insert tongue, and clamp together as in making the ring. Sweat the two pieces together with solder, and solder the end of the tongue to the buckle. If the band works loose while making the bracelet, solder it on also. Bend the outer ends around in a circle and shape until the bracelet fits the arm.



If a bracelet with more spring is desired, use 20-gauge German (nickel) silver instead of monel metal. A contrast may be had by making the bands of German silver and the buckle tongue and strap of monel.

If desired, both ring and bracelet can be planished with a small ball-pein hammer, or designs can be cut or stamped into the metal.—W. T. BAXTER.

These pieces of jewelry are original and decorative, yet comparatively easy to make

PANELS OF GLEAMING BRASS SET OFF THIS

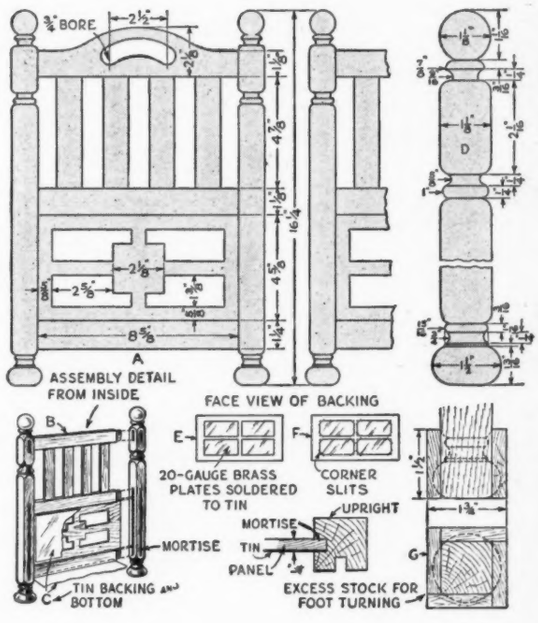
Decorative Wastebasket

A design that will show your skill without costing much for materials

By J. I. SOWERS

Director of Industrial Arts
Miami Evening Schools, Miami, Fla.

In style, novelty, and workmanship, this wastebasket is far superior to ordinary designs, made for use rather than beauty. The plans appear at right



IT IS usually difficult to purchase a correctly styled basket for waste paper. That this article of furniture should fit in with the general scheme of room decoration is a matter which seems to be ven little thought. The Colonial design trated above lifts this neglected ar- into a class with other well-designed pieces, and makes it a thing of beauty as well as use.

Select a wood in harmony with the Colonial design, such as walnut or cherry. If these woods are difficult to obtain, others may be used and stained and finished to imitate them. Both red gum and mahogany take a good walnut stain. Oak, too, may be used and stained brown, but it is less desirable for Colonial type furniture.

Work out the four uprights first; these are 1⅛ in. square and 16¼ in. long. After squaring up this stock, cut it to about 17 in. long to provide waste stock at the ends for turning. As will be seen in detail drawing *D*, the base turning is larger than the rest of the upright. In order to make this turning, extra stock will have to be glued to each upright as shown at *G*. Care should be taken to produce a good, sharp, accurate piece of turning.

The next step is to make the side rails, which are fastened with mortise and tenon joints, as in the assembly drawing *B*. To simplify the work a little, ⅜-in. dowel fastenings may be used instead; however, the mortise and tenon joint makes the best fastening and is more truly Colonial. It certainly should be used if one has machine tools.

Two of the upper side rails are shaped into handles as shown at *A*. The boring should, of course, be done from both sides to avoid splitting.

The two bottom rails are grooved to receive the panels, as are also the uprights.

The panels, as shown at *E*, are made of ¼-in. stock backed by a sheet of tin. Four small pieces of 20-gauge brass are soldered to a tin backing sheet in such a way as to show through the openings in the panels. If it is not convenient to solder these pieces of brass to the tin, they may be attached as shown at *F*. The brass is polished with a piece of fine sandpaper or with fine steel wool and given a coat of clear lacquer to prevent tarnishing. This is done before the work is assembled.

The design for cutting out the wood panels is only a suggestion; any other suitable pattern may be used, provided it is in harmony with Colonial design.

The bottom is a piece of sheet tin, tacked in place with ⅝-in. No. 14 brass escutcheon pins as shown at *C*. After the piece is assembled, the tin back of the panels and the bottom are painted with dull black paint.

The finished piece is stained with walnut oil stain and given a thin wash coat of shellac. This is ordinary shellac thinned with four parts alcohol. After this it should be given an oil finish. Early cabinetmakers produced this finish by applications of raw linseed oil. The oil is applied frequently during a period of a number of days; and each application is allowed to dry about one hour and then thoroughly rubbed off. This eventually makes the most beautiful and durable finish that can be applied to wood. Any good book on wood finishing will give more information about oil finishes. If this finish is not used, however, the piece may be varnished and given a rubbed finish with pumice stone. In no case should the finish be brought to a high polish. Newness is to be avoided. Try to give the work an appearance of age.

HOT OIL PRESERVES HARDWOOD

A DURABLE, climateproof, antique finish may be given walnut and other hardwoods by pouring boiling-hot linseed oil over the unfinished wood. The surface is then sandpapered or rubbed to a smooth finish, and the process repeated until the wood is as dark as desired. It is then polished with wax.—L. W. HENDERSON.

Solder rivets make joints much stronger

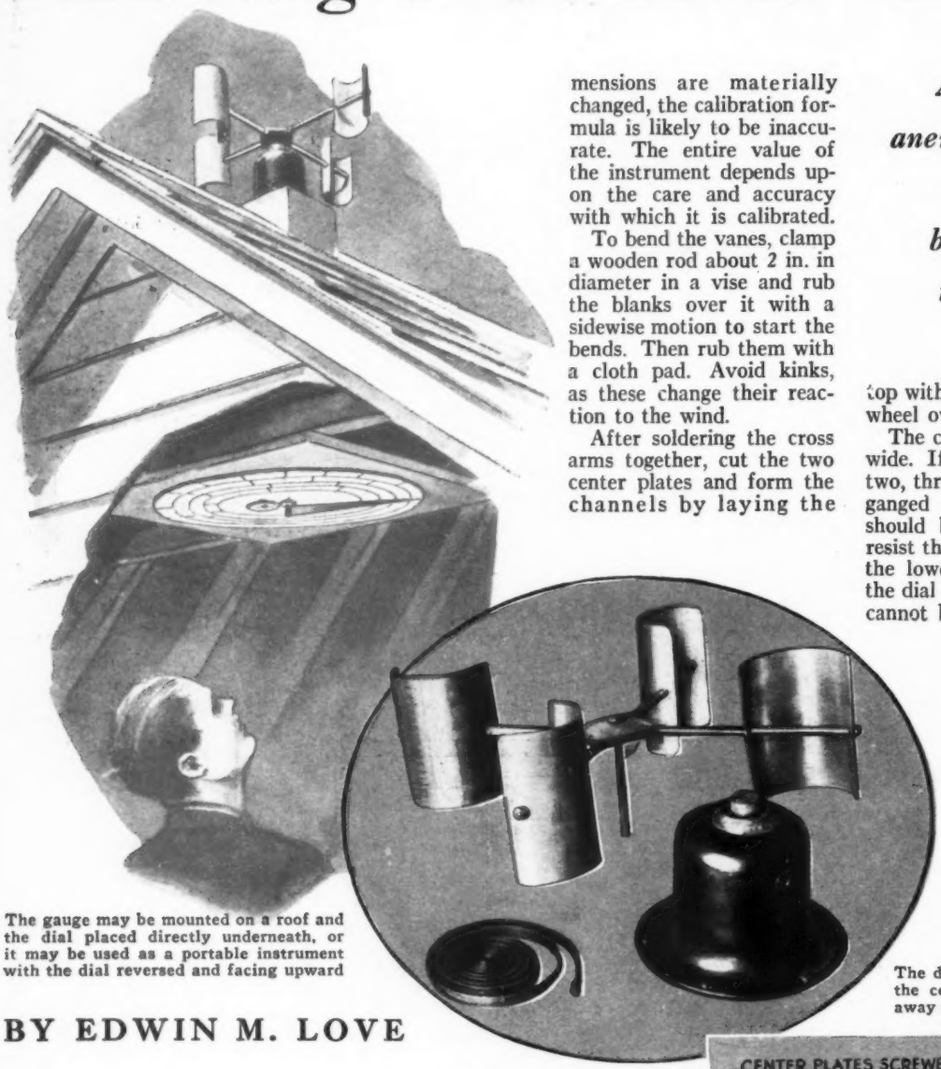
SOLDERING GALVANIZED IRON JOINTS

AFTER constructing an aquarium frame out of galvanized iron, I learned that the strength of any galvanized iron parts soldered together by the usual methods is no greater than the adhesion of the galvanizing itself. A sufficient strain upon the solder will pull the galvanizing off the metal.

This limitation is easily overcome by drilling one or more small holes through the two parts before soldering. Fill the holes with solder, and you have what is virtually a rivet of solder. In soldering galvanized iron, use undiluted muriatic acid.—JOHN EDWIN HOGG.

Making a WIND GAUGE

A highly simplified anemometer in which the vanes do not spin, but turn against the torsion of a spring



The gauge may be mounted on a roof and the dial placed directly underneath, or it may be used as a portable instrument with the dial reversed and facing upward

BY EDWIN M. LOVE

A 231-MILE wind tore at the Mt. Washington, N. H., meteorological station not long ago. The pressure on the cabin must have been more than 240 lb. per square foot, and the force against a section of wall 8 by 10 ft. at least 9½ tons!

It is always interesting to speculate on the velocity of the wind, whether a gentle breath that ripples the water and makes the leaves dance, or a rending gale that lifts roofs and rips branches from the trees. From odds and ends you can build an anemometer that will indicate this velocity, provided it is properly calibrated, more accurately than the speedometer on your automobile usually registers your driving speed.

This meter does not spin continuously, but is of the direct-reading pressure type, with cup vanes that revolve in the wind against the torsion of a spring until the two forces balance. The drawings show the construction clearly, but a few points must be especially noted. It should be remembered that each anemometer has its special characteristics, so that if any dimensions are materially changed, the calibration formula is likely to be inaccurate. The entire value of the instrument depends upon the care and accuracy with which it is calibrated.

To bend the vanes, clamp a wooden rod about 2 in. in diameter in a vise and rub the blanks over it with a sidewise motion to start the bends. Then rub them with a cloth pad. Avoid kinks, as these change their reaction to the wind.

After soldering the cross arms together, cut the two center plates and form the channels by laying the plates on a pine block and hammering with a rounded cold chisel. When the two are done, bolt them to the arms and solder solidly.

Assembled vanes, the horn-motor cover that serves as a support, and the clock spring, which is set inside the housing

Now drill for the spindle, solder it in, and solder the cups on. Balance the assembly by driving solder into the light ends of the arm tubes.

The spindle bearing is a skate wheel which costs about 15 cents at a hardware store. Select one with a minimum of side play.

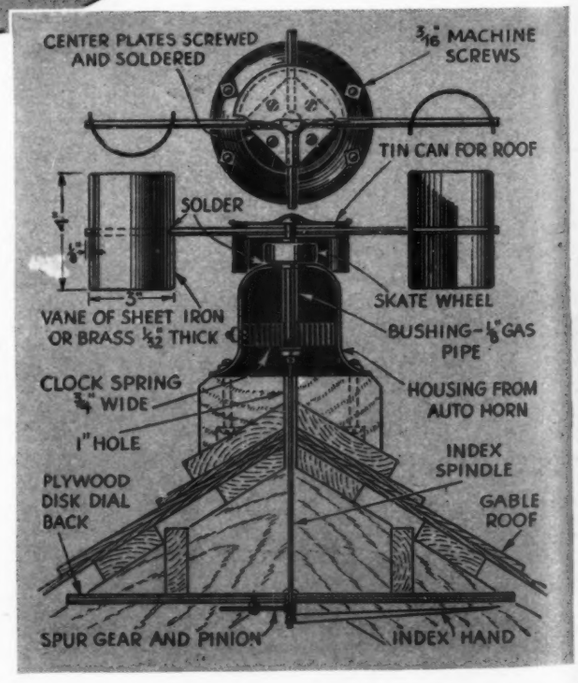
From an automobile wrecking yard obtain a horn-motor cover having a flange so that it can be bolted directly to the base. Chop a hole in the top with a cold chisel and solder the skate wheel over it as shown below.

The clock spring must be at least ¾ in. wide. If very high velocities are common, two, three, or four springs will have to be ganged together. The cross arms then should be made of heavier material to resist the strain. This, of course, cuts out the lower velocities, since the points on the dial will be so close together that they cannot be read; yet, even so, it is likely that breezes of five miles would be indicated.

Break off enough of the spring that it can be entered in the housing without rubbing much on itself. Punch a hole in the outer end, and drill one in the housing to receive a bolt.

Set the spindle in the bearing, slip on the bushing, install the spring and washer, and tighten the nut, burring the end of the spindle to prevent loosening. Drill a ⅛-in. hole for

The drawings below show a side view of the complete installation and a broken-away top view of arms, vanes, and housing



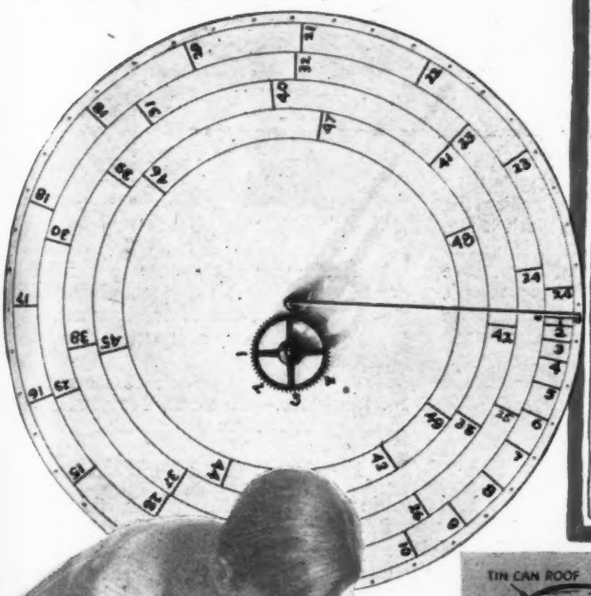
the index-hand spindle. Solder on the tin-can roof.

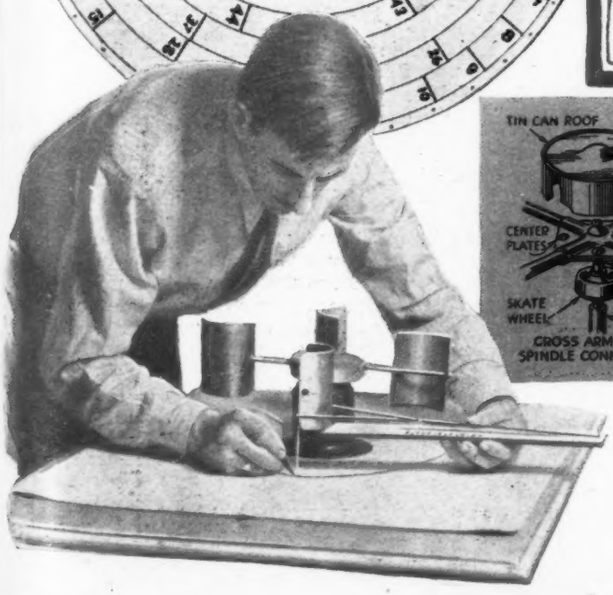
The instrument is now ready for calibrating. Solder a stiff wire to the edge of one vane to act as a pointer, and stand the apparatus on a piece of paper on a table in a room free from drafts, so that the zero point can is located. Mark this with a pencil. Now tie a string loop to the hook of light spring scales, slip the loop under a vane, adjust the scales to pull at right angles to the center, and draw the arm around until the reading is ½ oz. Take a similar reading at 1, 1½, and 2 oz. Now check these readings with each other, and if the marks on the dial are not equidistant, take new readings. The scales must be at right angles to the vanes.

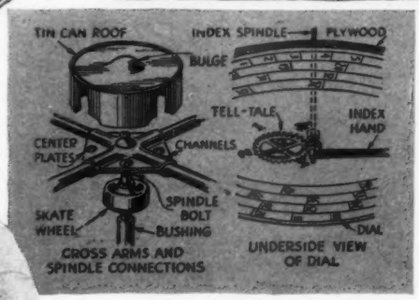
If suitable scales are not available, you may make a substitute by tacking a rubber band to a strip of wood. Tie a loop of string to the free end of the rubber, load it with a ½-oz. weight, and mark the position of the knot on the wood. Do the same for 1, 1½, and 2 oz. Then use this device for calibrating the anemometer as shown in the photograph at the bottom of this page.

Dismount the anemometer and draw four circles as shown. Four are necessary because the vanes, when registering up to 45 M.P.H., sweep four times around the dial. The division points may be calculated according to this formula, which is much easier to work out than may appear at first glance: $d=DAV^2/2011.35$, where "d" stands for degrees, "D" represents degrees deflection obtained with a pull of 1 oz., "A" is the average area of the vanes, and "V" is an assumed velocity.

To illustrate: The length and breadth (diameter) of all vanes, multiplied together, added, then divided by four to get the average=12.19=A. Deflection in degrees with 1 oz. pull=101.25=D. Assume a wind velocity, say 23 M.P.H. Then $d=101.25\times12.19\times23\times23\div2011.35=324.6$ degrees.







Ceiling dial with telltale to indicate which circle to read; construction details; and, at left, measuring deflection with improvised scales made from a rubber band and stick of wood. Such scales, of course, must be calibrated in advance by the use of druggists' weights

SET UP A LITTLE

WEATHER BUREAU

OF YOUR OWN

WEATHER is the one great universal topic of conversation. Is it going to snow? Will it get warmer? Is a storm blowing up? Will there be a heavy frost tonight? You are always asking these and countless other questions, and talking about them to your friends. Why not make a real hobby out of the weather and start a little weather bureau of your own? As soon as you have a few instruments, you will find it fascinating to watch them, and you will quickly learn to forecast changes in the weather with surprising accuracy.

Much can be done with three instruments—a high-grade thermometer, a barometer, and a hygrometer. These are available everywhere and do not cost a great deal. If you are handy with tools, you can make an anemometer as described in the accompanying article, and other instruments may also be constructed as your weather bureau expands. You will also need to consult the daily government weather map. It is now published regularly in some of the larger newspapers and usually can be seen at post offices or public libraries if you do not wish to subscribe for it yourself. And, of course, you can listen to detailed weather reports over the radio.

Do you want to try this hobby? If so, send a post card to the Home Workshop Department with a request for more articles on weather. Please indicate whether you would like to make a maximum and minimum thermometer, a mercury barometer, a hygrometer, or a seismograph.

It is unnecessary to do all this multiplication every time a point is calculated. DA/2011.35 occurs every time; therefore obtain this amount and multiply the V^2 by it. Again illustrating, with my anemometer, $101.25\times12.19\div2011.35=0.614$, and the formula becomes $d=0.614\ V^2$.

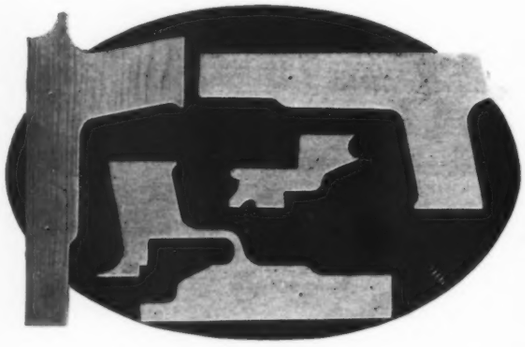
A table of squares is appended, which will save the trouble of squaring V.

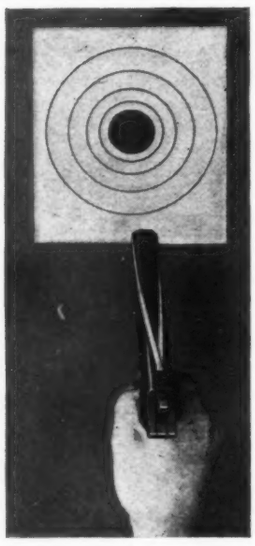
If you have a slide rule, set 1 on scale C over DA/2011.35 on scale D, with the rider glass over V^2 on scale C, and read the deflection beneath on scale D. After this, to read off a new deflection, it is necessary only to slide the rider to a new V^2 on C, and read from D.

Use a protractor to locate the points on the dial. When *(Continued on page 87)*

Rubber Band Pistol

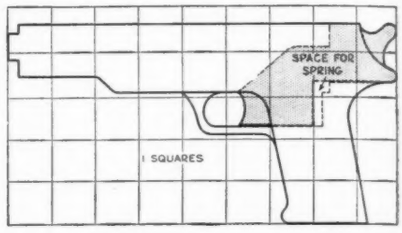
LOOKS LIKE REAL "GAT"





The pieces that have no hammer or trigger guard form the side plates. Between them is set the piece with the trigger guard. In the opening of this part is placed the combined trigger and hammer. At right is the gun ready to shoot

Pulling the trigger moves the hammer back and lets the end of the rubber snap forward



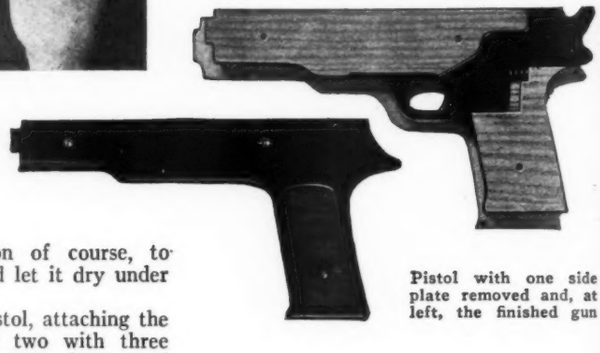
HERE is a wooden automatic pistol that looks like the real thing and shoots rubber bands with surprising accuracy.

Obtain three pieces of clear white pine ¼ by 5 by 10 in. and fasten them together with a few brads. Lay out a full-size plan of the pistol and transfer the drawing to the top board with carbon paper. Saw all three pieces at one time on the outside lines. Then separate them, and from the top and bottom pieces cut away the trigger guard and hammer.

Lay out the combined trigger and hammer on the center piece and saw it out. Also saw out the trigger guard, taking great care not to break it. If the trigger guard is shellacked as soon as it is sawed out, it will be less likely to break. Rub the trigger-hammer combination flat on a sheet of fine sandpaper, thinning it down from both sides so that, when assembled, it will move freely between the other pieces. A small coil spring from a baby battery clip, sold in the ten-cent stores, or from any other source, is used as shown to hold it in the forward position.

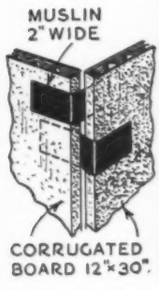
Glue the center section, without the trigger-hammer combination of course, to the right-hand piece and let it dry under a weight.

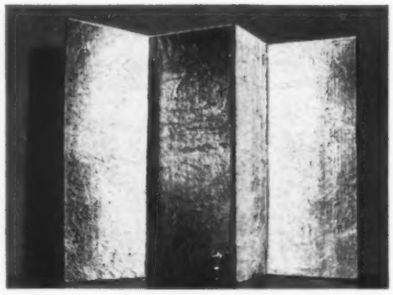
Now assemble the pistol, attaching the left-hand to the other two with three small screws. Then round, shape, and smooth the weapon to its final form. Give it a coat of shellac and, when dry, sand it to a very smooth finish. Mix a little lampblack with some blue paint until about the color of blue steel and paint the gun. The handle plates may be marked out and painted brown, if desired.



Pistol with one side plate removed and, at left, the finished gun

To load, pull the trigger to raise the hammer and insert the doubled end of a rubber band in front of the hammer. Let the hammer down on it, then draw the other end down over the muzzle end. A pull on the trigger will shoot the band a good distance.—CLARK H. RUTTER.





FOLDING PORTRAIT REFLECTOR

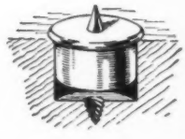
THIS compact portrait reflector will be appreciated by amateur photographers because it can be folded up and is light in weight. Four pieces of heavy corrugated board are cut to the same size—in this case, 12 by 30 in. Twelve strips of muslin are then glued as shown to form hinges.

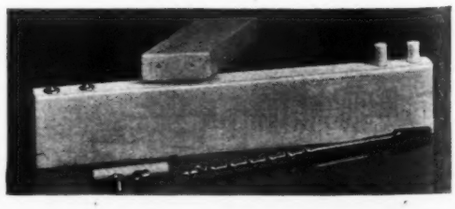
After the glue has dried overnight, sheet tin foil is glued on one side of the reflector. The tin foil may be obtained at any photo supply store at trifling cost. The back may be covered with some dark material, if desired, for use as a background when needed.—JOSEPH KNIPP.

QUICK WAYS TO MARK DOWEL HOLES

ALTHOUGH few beginners in woodwork are familiar with them, the small steel markers known as "dowel centers" save much time in making blind dowel joints. The holes are first bored in one of the pieces to be joined. Then dowel centers of the same size are inserted in the holes as shown at the left of the photograph below, and the joining piece is placed in position and pressed against the sharp points. The resulting indentations show where to bore the matching holes.—W. H. MCCULLOUGH.

When dowel centers are not at hand, marks for boring both sets of holes can be made simultaneously in the two pieces by using ordinary pins. Hold one of the pieces in the vise with the joint edge horizontal and lay pins on the edge with their heads where the centers of the dowel holes are to come. Then carefully press the second pieces in position without disturbing the pins.—A. W.





Graceful but Easy to Build...

A Colonial Corner Cabinet

Designed By

FRANKLIN H. GOTTSHALL

For the display of treasured ornaments, this corner cabinet fills a need that exists in almost every home, and it is also attractive in itself

BEAUTIFUL little pieces of pottery, vases, decorative metal work, and other bric-a-brac are accumulated in every home. No better place to display them could be found than this tall, graceful Colonial cabinet. It will brighten up the corner of any room. For so fine a piece of furniture, the construction is relatively simple. The original cabinet was built of red gumwood, finished in Vandyke brown, but any cabinet wood may be used.

First cut the sides to length, dress and shape the ends, and sand them. One edge of the wider side must be rabbeted, so that both sides may be fitted and nailed together to form a 90-deg. angle.

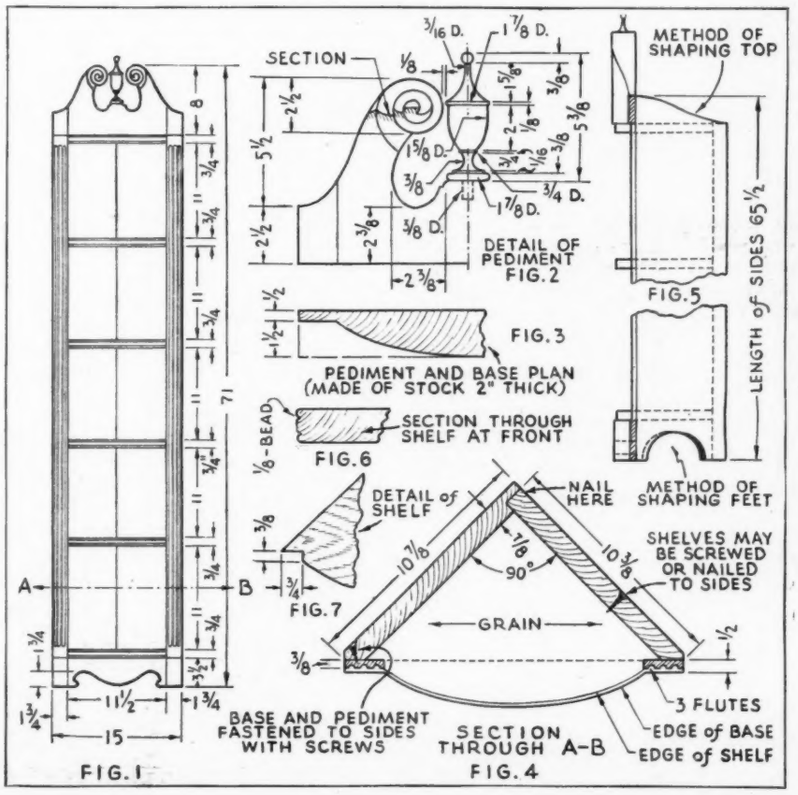
The shelves now should be cut as in Figs. 4 and 7 from a board ¾ by 8½ in. The grain should run as indicated in Fig. 4. The writer prefers free-hand curves for the fronts of these, but compass curves could be substituted. The beading should then be cut along the front edges of the shelves as in Fig. 6. If a shaper or an electric router is not available, these may be cut with a carver's V-tool. The fluting on the vertical strips, at the edges of the cabinet, may likewise be cut with a carver's gouge of the correct size.

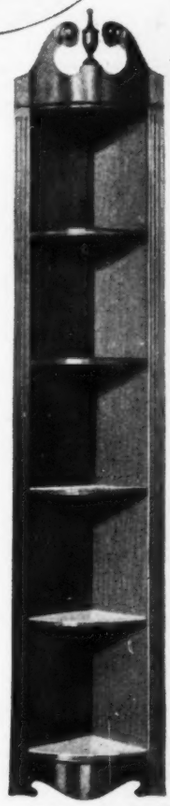
When the six shelves have been nailed into place, lay out the top edge of the pediment (Fig. 3) with a cardboard pattern on a piece of stock 2 by 8 by 15 in. This may be cut to the correct contour with a chisel, as the piece is almost too wide to be cut on the band saw; nevertheless, if a sharp saw blade is used, it can be done. Next lay out the shape shown in Fig. 2, turning the pattern over to get the other half, and saw it out. To carve the Ionic scroll, first cut around the lines with a carver's V-tool, then finish by shaping with a carver's flat gouge, as shown in the cross section detail of Fig. 2. Proceed in a similar manner to shape the ornamental base.

The base should be fastened to the sides with screws from the back as indicated in Fig. 4. Next fasten the fluted strips, and finally the pediment. The finial, which is turned in the form of a classic urn, is fastened by means of the small dowel turned on its base.

On the piece shown, the finish consisted of Vandyke brown oil stain, followed by a wash coat of shellac, and two coats of a high-grade floor varnish. The final coat was rubbed with pumice stone and oil to give a smooth, velvety finish.

The scrolls of the pediment are first outlined carefully with a V-tool, then finished with a flat woodcarving gouge





The original piece was made of red gumwood, stained Vandyke brown and varnished. At left are the complete assembly drawings with all essential details

Preparing Guns *and* Spars

By Capt. E. Armitage McCann

WE ARE now ready to equip our privateer model *Swallow* with guns. Those who have not started to build this model but wish to do so should read the previous articles in this series (P.S.M., Nov. '34, p. 65, and Dec., p. 71).

The bulwarks are pierced for ten guns, but it was a common custom not to carry the full equipment. I have given my model only six of the six-pounders and one long twenty-four-pounder, carried amidships. You may, of course, give her the full complement.

The shape and size of these guns are shown in the detail drawings near the end of this article, and the positions are given on the previously published deck plan. They are best turned from brass, but may be turned or filed from wood, or cast in brass or lead. Brass guns should be oxidized; if of other materials, they should be painted black.

Six-pounders were from 6 to 8½ ft. long. I made mine to scale 7 ft. in length with a caliber (size of shot) of 3.7 in. Twenty-four-pounders were from 9 to 9½ ft. long, with a caliber of 5.8 in. The thickness at the breech is about three times the caliber, and at the muzzle, twice the caliber. The trunnions (crossbars) are placed at a point four-sevenths of the length from the muzzle.

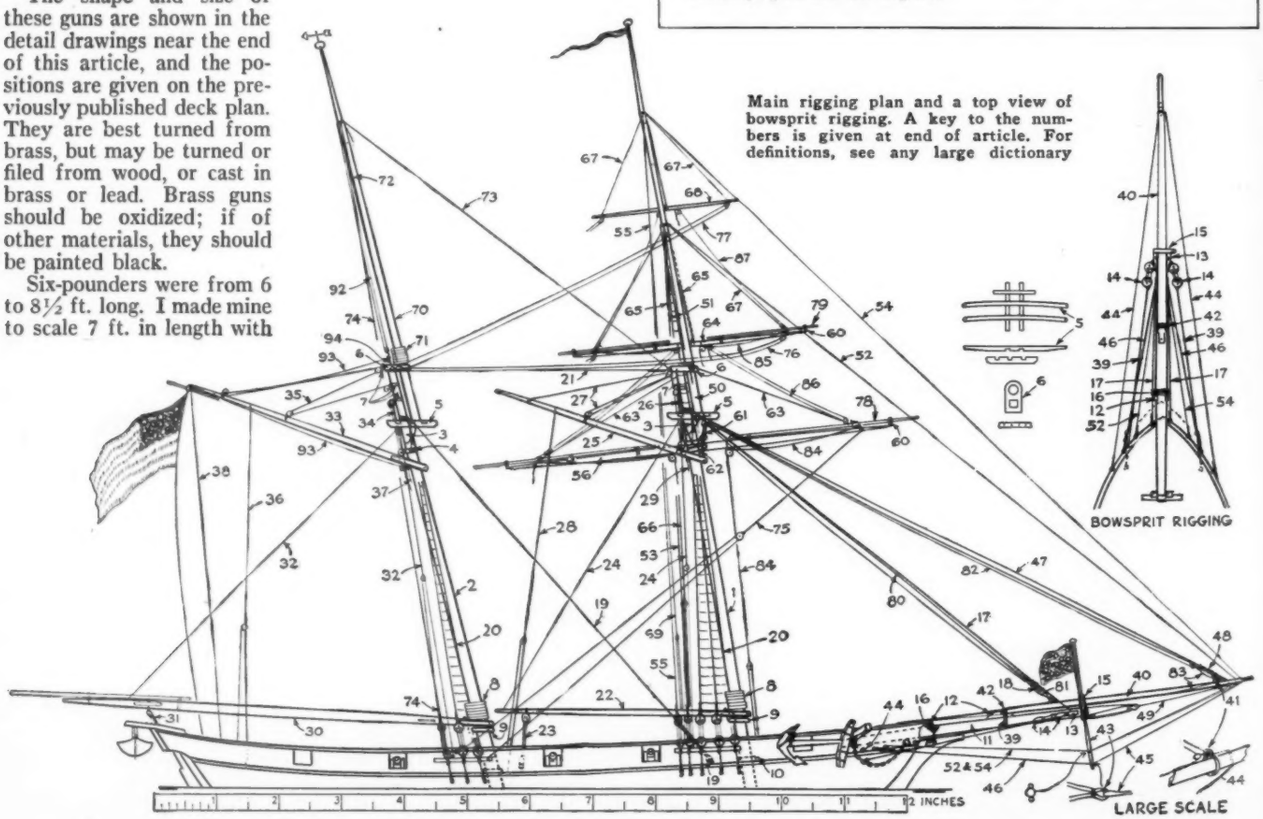
The carriages are four pieces of wood glued together, with the wheels on wooden axles that go under the carriages. The front wheels are slightly larger to compensate for the camber of the deck. The wedge at the back is to lift the breech. The guns, when level, should point through about the middle of the gun port. Notches are filed for the trunnions, and the guns are held down with bent-pin staples, except the large gun, which should have a piece of metal nailed over for this purpose. Eyebolts are needed on the back steps for the tackles, and a ringbolt in the middle (at least on the large gun). They are all black. Simpler carriages may be made from an oblong stick with a groove in it to take the gun; and instead of wheels, round sticks may be used.

The guns are pulled up to the bulwarks with a tackle of two single blocks on each side. The blocks are strapped with wire hooks to go to the rings in the carriage and in the waterway. The ends are hitched around all parts. The breechings to take

Ahoy, ship model makers!

How Much Do You Know about RIGGING?

HERE'S a game to test your knowledge. You can try it whether you are building the *Swallow* or not. Look at the accompanying rigging plans, note the numbers, and see how many of the parts you can identify correctly by name. When you have made your list, compare it with the one on page 88. If you have as many as thirty correct, your knowledge of nautical terms is far above the average; if more than fifty, your mark is excellent; if more than seventy, you are an expert.



Main rigging plan and a top view of bowsprit rigging. A key to the numbers is given at end of article. For definitions, see any large dictionary

for Our *Privateer Model*

the recoil are of heavier cord. They run from the rings in the timberheads and are seized under the cascabels. They should be slack enough to allow the muzzle to come inside the bulwark, and by rights should go through the rings in the sides of the carriages.

The gear for the large gun is similar except that, instead of a breeching, there is a gun tackle, leading aft.

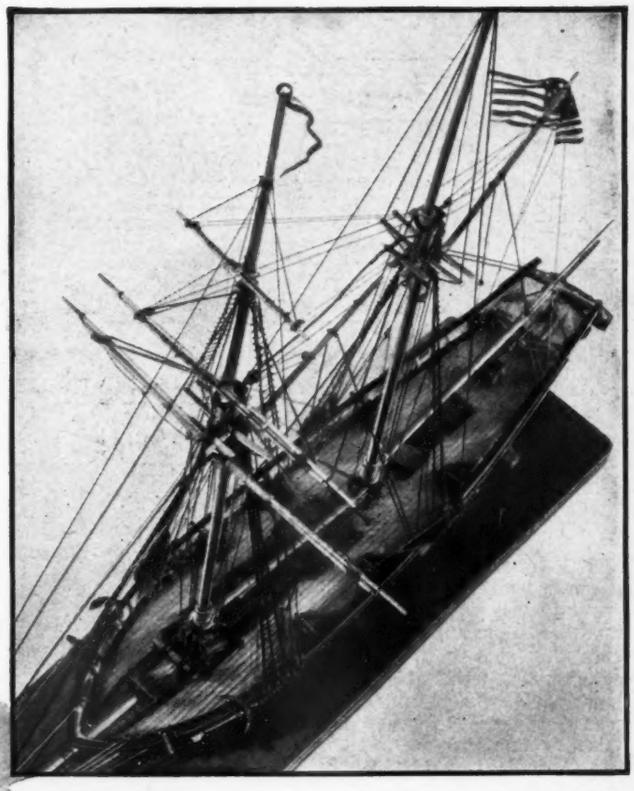
If these guns are glued down and a pin point driven through the back step or crossbar, they will remain in place.

Now for the rigging. First we must make a set of spars. Any straight-grained wood will do, but carefully selected dowel sticks are the easiest to use. You will need about 24 in. of ¼-in. doweling, 36 in. of 3/16-in., 24 in. of ⅛-in. and four 1/16-in. applicators (swab sticks) about 6 in. long for the stuns'l (studding-sail) booms, flagstaff, and the capstan bars described last month.

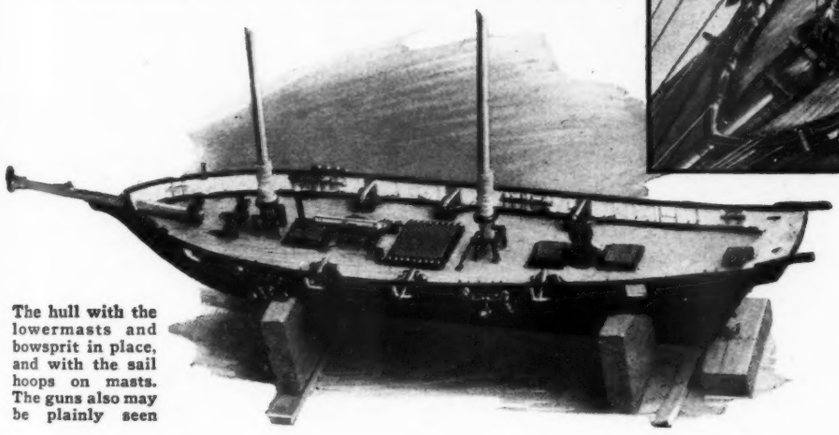
If the model is hollow, the lower masts must be long enough to reach the bottom of the hull, inside, where a double-pointed spike may be used to hold the heel in place. These masts taper very slightly and are square from the trestletrees up, with a smaller square at the top to set in the cap. The various fittings should be put on before the mast is shipped.

The crosstrees half-lap into the trestletrees, with one square opening to fit the lower masthead and the other to fit the topmast heel. Note that the holes in the boom supports and mast coats are at an angle, to lie horizontal.

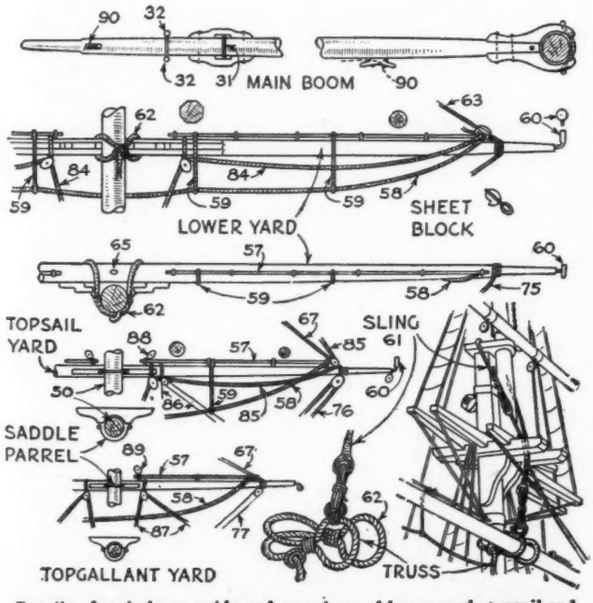
The mast hoops for the fore- and mainsails, if used, can be made neatly over a stick the size of the mast, around which a piece of waxed paper has been wrapped twice. Make some thin shavings, wet them well with casein glue, and wrap them around the paper. When dry, sandpaper them and cut off sections with a sharp knife. There should also be some smaller ones on the main topmast for the gaff topsail.



How masts and spars are set up. Note particularly the crosstrees and the position of yards



The hull with the lowermasts and bowsprit in place, and with the sail hoops on masts. The guns also may be plainly seen



Details of main boom; side and top views of lower yard; topsail and topgallant yards; perspective sketch of crosstrees, yards, and truss

I made my model with enough running gear so that the sails can be readily bent, but all sail gear (items 80 to 98 in the list) may be omitted, because this gear would be stowed away if the vessel was to be in harbor for long.

The yard fittings are shown in detail. The jackstays are made from semihard, thin wire, and the staples from the same wire, bent double and hammered close after the rods are threaded on. The footropes (horses) and stirrups are made from covered magnet wire, stained black, because cord will not lie in place. The splices are just one twist of the wire. The stuns'l boom irons are made from pins hammered partly flat, bent into a circle, then at a right angle; and the ends are driven into the ends of the yards. All of these may be omitted from a simple model.

Topsail and topgallant yards are the same, except in the number of horses.

The lower yard is eight sided and is parallel for one quarter of each half. The others are round all the way along. The saddles of the upper yards have small eyebolts to take a lashing abaft the mast when fixed.

Stuns'l booms are the same length as the yards, but cut into two. They are about one third as thick.

The bowsprit is thickest where it comes out of the bulwarks. It has the end squared for a cap and has bees (cleats with holes) on either side for the two parts of the forestay to reeve through. On it is a notched cleat for the end of the jib boom to butt against, and two little cleats to prevent the gammoning from slipping.

(Continued on page 88)

THREE ECONOMICAL PLANS FOR

Laying Out a Workshop

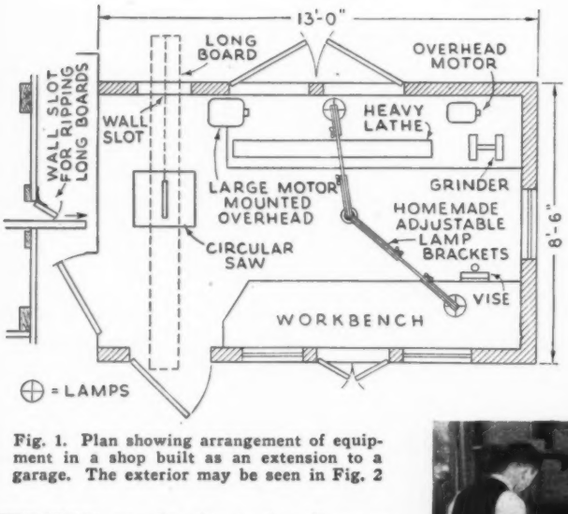


Fig. 1. Plan showing arrangement of equipment in a shop built as an extension to a garage. The exterior may be seen in Fig. 2

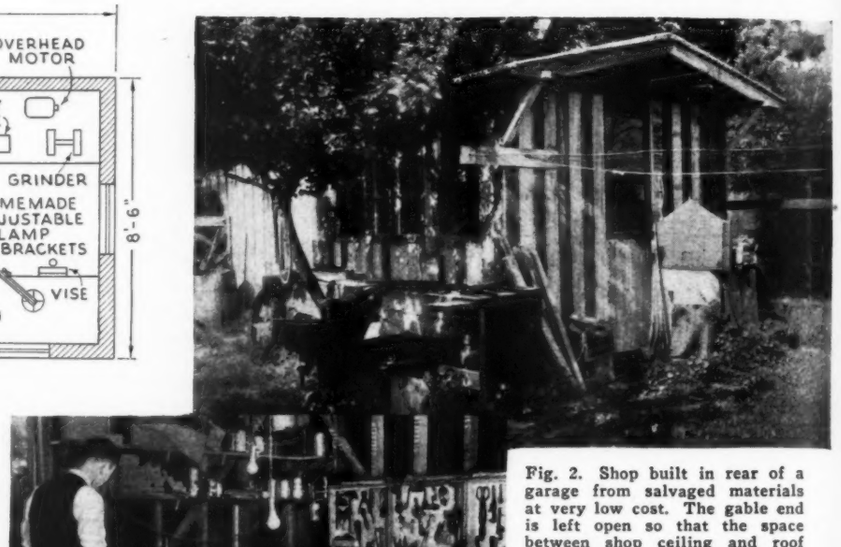


Fig. 2. Shop built in rear of a garage from salvaged materials at very low cost. The gable end is left open so that the space between shop ceiling and roof can be used for storing lumber

IF YOU are planning to install motor-driven machines in your home workshop, you will find it helpful to study the three practical and inexpensive layouts illustrated in the accompanying diagrams. They will give you an idea of how the other fellow goes about it. These plans supplement the suggestions contained in four previous articles in this series (P.S.M., Aug. '34, p. 83, Sept., p. 74, Nov., p. 90, and Dec., p. 92).

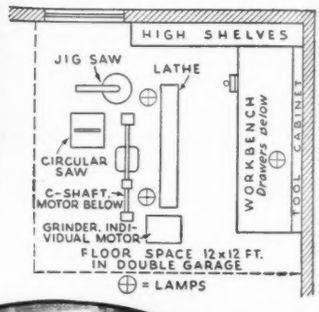
The shop shown in Figs. 1 and 2 was built by D. D. Galbraith, a carpenter of Pasadena, Calif., as an addition to the rear of his garage. He used old boards and other materials salvaged from various jobs. This imposed certain limitations, but enabled him to keep the cost very low. The addition houses several machines for which there was no room in the garage itself—a large lathe, a 12-in. circular saw, and a grinder—as well as a well-lighted workbench. The large motors that drive the machines are mounted on the wall above and back of the equipment, partly to give more space and partly to allow the use of longer belts, with their greater efficiency. The circular saw is placed in line with the door, and a wall slot makes it possible to rip long stock. Adjustable lamp brackets made of wood can be shifted so as to throw a good light wherever needed. The space above the ceiling and under the roof serves as a lumber rack. To give access to this storage place, the entire gable end is left open—a novel arrangement made possible by the equable climate.

In Fig. 3 is shown the plan of a shop set up in a corner of a double garage. The arrangement of machines is unusually compact, but daylight illumination is inadequate. A combination of individual drive and countershaft is used.

Another shop in a double garage is shown in Fig. 4. The machines in this case are installed on a long bench and driven by a single motor.

Except for the heating problem in the colder sections of the country, a double garage offers excellent opportunities for installing a shop.—HI SIBLEY.

Fig. 3. A shop laid out in the unused space of a double garage. The lighting will be improved when windows are cut above the tool rack and reflectors provided for the lamps. The plan is given at right



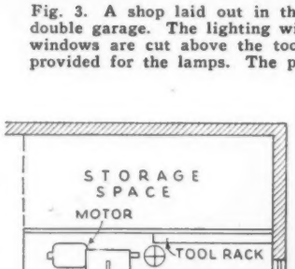


Fig. 4. Another plan for a compact and satisfactory shop in the corner of a double garage. One motor drives the machines, all on a single bench

GRADUATES HELD IN RACK UNDER SHELF

GLASS graduates used in chemical experiments, in mixing photographic solutions, and for similar purposes can be kept handy without waste of shelf room by sliding them into racks made as shown. Rabbeted strips of wood are fastened on the underside of a shelf in such a way that the foot of each graduate can be slipped in, as if on a track. In this way the graduates are securely suspended.

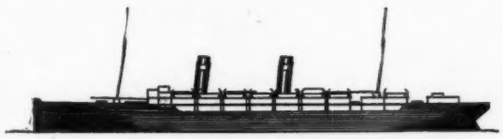
BUILD A LITTLE FLEET ALL YOUR OWN

WITH OUR

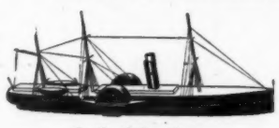
Construction Kits

THE new fashion in ship model making is to build a set of miniature models all to the same scale. They make a fascinating display and usually attract more attention than a single elaborate model. Furthermore, each individual model in the set is quite simple and easy to construct, and a whole fleet can be built in a comparatively short time.

The ideal models for this purpose are those designed for the Popular Science Model-of-the-Month Club. There are now seven in the set, all famous American ships of different periods and types—*Atlantic, Savannah, St. Louis, Brooklyn,* typical World War destroyer, *Saratoga,* and *Tuscaloosa.* Others will be added from month to month.



KIT O—An 11-in. model of the S. S. *St. Louis*



S. S. *Atlantic*

S. S. *Savannah*

Three famous ships. The two small ones are in one kit

These are the simplest of all our models. They are beautiful little water-line ships made mainly of balsa wood. A unique layer-built method of construction is used, so that they can be put together with no other tools than a pocketknife, some razor blades, a pair of pliers, and a few small drills.

In spite of the fact that they have been greatly simplified, these models are accurate in all essential respects. They have been prepared after much research from plans of the real ships by Theodore Gommi, a shipping expert who has collected data on famous vessels and built miniature models of them for years. What makes the models far more interesting, too, is the fact that they are all built to the same scale—1 in. equals 50 ft. They should not be confused with the many cheap and, for the most part, inaccurate models offered in toy construction kits.

KIT P—Yacht *Rainbow*

The kits contain all the raw materials, paints, blueprints, and instructions. The prices are 75 cents and $1, as shown in the following list.

In addition to the historic models, there is one project in the Model-of-the-Month Club series that was added for its current interest. That is the cup-winning yacht *Rainbow.* It is, of course, built on a larger scale.

If you wish to try something a little more elaborate—models that include the underwater part of the hull—you have a choice of three, listed under the heading of "simplified ship model kits." In these kits the hulls are furnished roughly shaped, and various finished and semifinished parts are included.

For those who wish larger models, there are our standard kits. Although not particularly hard to construct, the models themselves are of a very fine type and some of them are worth several hundred dollars each if carefully built. There is ample choice for everyone—the famous *Hartford,* the modern battleship *Texas,* two galleons, one Spanish and the other English, a wonderful old whaler, and the rakish Baltimore clipper *Swallow.*

In addition, we have a few specially designed furniture kits. All the machine work has been done, and the parts can be put together after a little hand finishing and fitting. These are distinctive custom-built designs and of superior quality throughout.

STANDARD SHIP MODEL KITS

A. Whaling Ship *Wanderer,* 20½-in.....$6.90*
AA. Same with hull lifts sawed..... 7.40*
D. Spanish galleon, 24-in..... 6.45*
DD Same with hull blocks shaped.... 6.95*
E. Battleship U.S.S. *Texas,* 3-ft..... 6.95*
EE. Same with hull lifts sawed..... 7.45*
G. Elizabethan galleon *Revenge,* 25-in. 6.75*
GG. Same with hull blocks shaped.... 7.25*
L. Farragut's flagship *Hartford,* a steam-and-sail sloop-of-war, 33½-in. hull..... 7.95*
LL. Same with hull lifts sawed..... 8.45*
Q. Privateer *Swallow,* 12½-in. hull, with lifts sawed to shape..... 4.95*

KIT NO. 2

KIT J—*Sea Witch*

KIT Q *Swallow*

This is Captain McCann's latest model

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga,* 18-in..... 1.00
N. Four U.S. destroyers, each 6¼-in... .75
O. Liner S. S. *St. Louis,* 11-in..... 1.00
P. Cup yacht *Rainbow,* 7½-in..... .75
R. U. S. cruiser *Tuscaloosa,* 11¾-in... 1.00
S. S. S. *Savannah* (first steamship to cross Atlantic), 3½-in., and S. S. *Atlantic,* 6-in. (two models in one kit)..... .75
T. U.S.S. *Brooklyn,* armored cruiser in Spanish American War, 8-in..... .75

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan,* 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis,* 12-in... 1.50
J. Clipper ship *Sea Witch,* 13-in..... 1.50

FURNITURE KITS

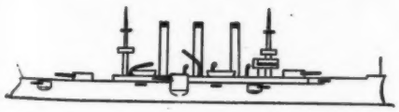
No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble, but without finishes..... 5.40*

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes..... 5.30*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included..... 5.75*

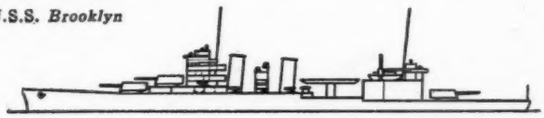
No. 6. Solid rock maple butterfly table, top 19 to 22 in., height 22½ in. Ready to assemble and stain included..... 6.90*

NOTE: If you live west of the Mississippi River, add 50 cents to all prices marked with an asterisk (*) because of the heavy shipping charges. Otherwise all prices are postpaid anywhere in the United States. The kits marked with an asterisk will be sent C. O. D. upon request, but the purchaser will have to pay 28 cents additional upon delivery.

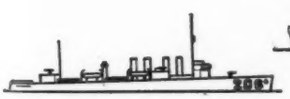


KIT T—U.S.S. *Brooklyn*

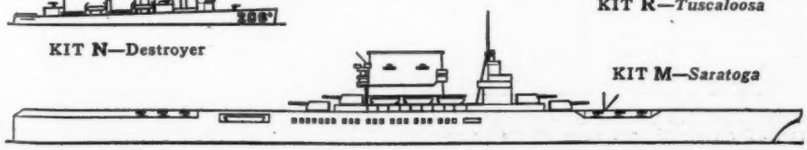
Here is a remarkable fleet of outstanding American fighting ships, all built to the scale of 1 in. equals 50 ft. The model of the aircraft carrier *Saratoga* is 18 in. long



KIT R—*Tuscaloosa*



KIT N—Destroyer



KIT M—*Saratoga*

Popular Science Monthly,
381 Fourth Avenue, New York, N. Y.

Please send me Kit.....for which I inclose $.....(or send C. O. D. ☐)

Name .....

Address .....

City .....State .....
(Print name very clearly.)

Please remember that no kits can be sent C. O. D. except as noted above. This offer is made only in the United States.

STEP-BY-STEP INSTRUCTIONS FOR

Making SKIS

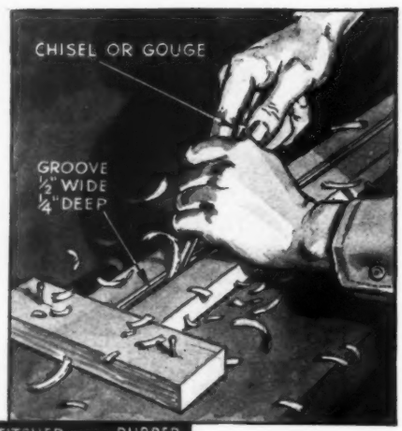
Skiing is an acrobatic sport of the most exhilarating type

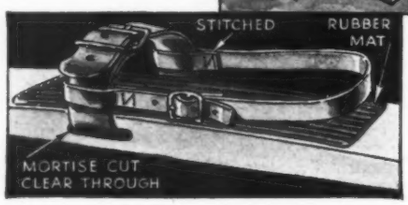
By
LEONARD F. MERRILL
Famous Maine Guide

A PAIR of skis will afford one hours of pleasure, and the job of making them is neither difficult nor expensive.

Materials: Two pieces of white ash, hickory, or beech, ⅞ by 4 by 78 in., two strips of strap leather, one ¾ in. wide and about 4 ft. long and the other 1½ in. wide and about 2 ft. long; two 1½-in. loop bar buckles; two ¾-in. loop bar buckles; one 9-ft. bamboo pole; a few strips of rawhide; two 20-penny spikes; 6 ft. of ⅛-in. iron wire; scrap lumber to make the bending board; rubber matting for foot plates.

The exact width and length of the skis is governed by the height of the user. The widths range from 3½ to 4 in., and the length is the height to which he can reach when standing. The skis described are for one who can reach about 6½ ft.





A groove is formed along the middle of the bottom from a point 8½ in. from the front to the opposite end. *At left:* How the harness is made and fastened

Tools. A plane, spokeshave, marking gauge, No. 3 or 4 bit, narrow chisel, awl and waxed thread, rule, try-square, knife, and ½-in. gouge.

Shaping. Square up one edge and one end. Gauge to width and measure to length. Select better side for bottom and gouge a groove ½ in. wide and ¼ in. deep from a point 8½ in. from one end down the middle to the other end.

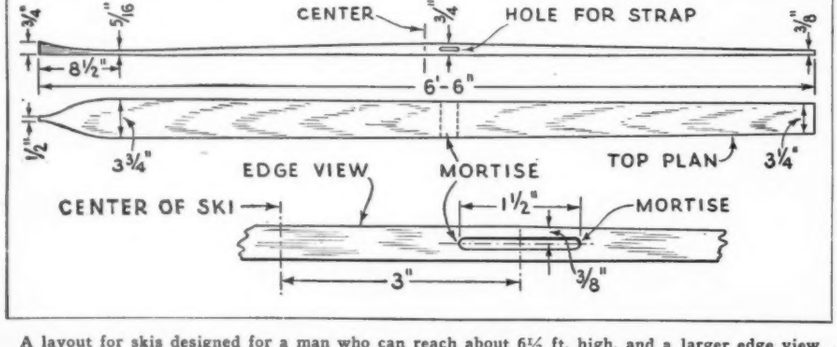
At the 8½-in. point the ski is the full 3¾ in. width and tapers from there to both ends. The toe end comes in with a curve, leaving a ½-in. tongue at the very tip. The heel taper is straight to 3¾ in. at the end.

Before cutting the sides of the ski, lay out and cut a through mortise for the toe strap as shown. The actual size of the mortise is governed by the size of the strap used. Then cut the sides to the lines.

The bottom of the ski is left perfectly straight, but the top is cut down. At the heel end it is ⅜ in. thick; at the 8½-in. point, 5/16 in.; at the extreme toe, ¾ in. The taper from the toe to the 8½-in. point is curved to allow for a smooth bend, but from there to the middle and from the middle to the heel it is straight.

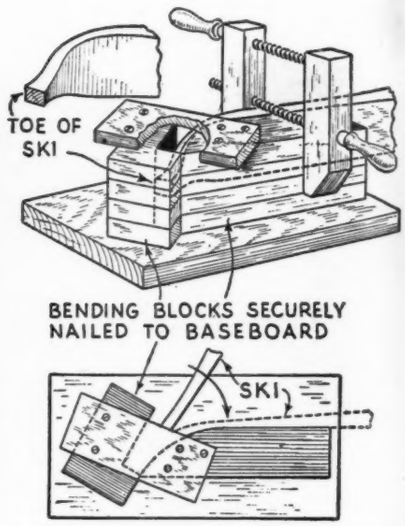
Sand the entire ski to a smooth, clear surface. At this point a marking gauge may be used to groove the upper side in a neat three- or four-line design. Merely remove the point of the gauge, grind it down to a fairly blunt round point, and replace it.

Bending. Build up a block about 4 by 4 in. square and from *(Continued on page 91)*



A layout for skis designed for a man who can reach about 6½ ft. high, and a larger edge view of the central part, showing the mortise or hole made for the wide toe strap of the harness

The points are softened with boiling water



Method of making and using the bending form

A professional finish is given the skis by scratching in lines with a blunt gauge

Final Rules Announced for the-

$2,000 NATIONAL HOMEWORKSHOP GUILD CONTEST

Official Magazine
POPULAR SCIENCE MONTHLY

The silver cup shown above will be awarded for the best example of model making entered in the National Guild Contest. A cash prize of $100 will accompany it. There will be nine other silver trophies. The group of amateur craftsmen at the left are members of the Billings Homeworkshop Club, Billings, Mont.

The first Popular Science silver medal to be awarded was won by C. J. Boeger, of the Topeka Club, for this picture frame

COMPLETE rules and regulations have now been formulated for the coming National Homeworkshop Guild Exhibition and Contest. It will be held in Chicago, March 25 to 30, 1935. As previously announced (P. S. M., Oct. '34, p. 72), there will be thirty-eight prizes amounting to $2,000 in cash and including ten silver cups and trophies. The awards will be made at a Guild banquet to be held before the close of the exhibition.

The current Guild Bulletin, which goes to each of the 119 local clubs now chartered by the Guild, contains the rules in detail. A summary is given here because so many readers who are not yet affiliated with the Guild have written to ask under what conditions they may compete. The principal condition, of course, is that they must be members of a club affiliated with the Guild. Since any five or more men interested in craftwork may organize a club and apply for a charter, this is a condition easily met. The fact that the Guild is strictly noncommercial and the dues are nominal makes the work of starting a new club still easier. Prompt action is necessary, however, in order that new clubs may get their charters and affiliate cards in good time to enter the contest. See the coupon at the end of this article.

The contest rules are, briefly, as follows:

1. All entries must be the work of clubs affiliated with the Guild or their members, and all projects must have been started since January 1, 1934.

2. Each project must be entered in only one classification. (These classifications were published in the October, 1934, issue.)

Awards will be made at great craftwork exhibition in Chicago next March . . . Local clubs to name national exhibition delegates . . . Scope of show is expanding rapidly

3. All work submitted must have been built or assembled by the contestant, but the design does not necessarily have to be original.

4. Projects that have been displayed at local club exhibitions are eligible.

5. Each entry must be accompanied by an official entry blank.

6. No entry fee will be charged.

7. Exhibits must reach Chicago not earlier than March 18, 1935, and not later than March 25, 1935. Suitable labels will be supplied.

8. Entries in Division 2, Civic Activities of Clubs, will consist of a loose-leaf notebook, scrapbook, album, portfolio, or other suitable binder containing the following: (a) A statement of what the club has accomplished in the way of civic or community activities. (b) Newspaper clippings (if available) showing the public recognition given to such work. (c) Any available photographs showing projects made for community use or illustrating the participation of the club in civic activities. (d) Copies of letters from officials of the community or other organizations relating to the civic activities of the club. (e) Any further evidence of such activities as the club may wish to present.

9. The Grand Sweepstake Prize,

Garage shop of Edwin J. Davis, a member of the Rockford Homecraft Club. He has made most of his own machine tools and is now working on a model of a steam threshing engine

designated as Division 10, will be awarded to the club that wins the most points in the other nine divisions. This prize is a silver cup and $200 in cash.

10. The decision of the judges will be final. In case of ties, each tying contestant will be awarded the prize tied for.

The local clubs are displaying so much enthusiasm and the whole program has been expanding so rapidly that it has been decided to enlarge the contest committee with representatives from many of the local clubs. As it stands at present, the committee consists of Raymond J. Brown, editor of POPULAR SCIENCE MONTHLY, chairman; LeVern T. Ryder, president of the National Homeworkshop Guild; Robert A. Horner, E. Raymond DeLong, and L. B. Achor, vice president, secretary, and treasurer respectively of the Guild; and Arthur Wakeling, a director of the Guild, home workshop editor of POPULAR SCIENCE MONTHLY, and secretary of the contest committee.

This committee is now to be supplemented by a group of national exhibition delegates. These men will be selected by the various local clubs and will serve as the local representatives of the contest committee. They will coöperate in the work of planning and organizing the exhibition, supervise the preparation of club exhibits and their shipment to Chicago, and, in such cases as may be convenient, attend the exhibition personally as representatives of their clubs and members of the central committee.

The remarkable progress made by the Guild during its first year was summarized by Mr. Ryder, president of the national organization, in an address before the annual convention of the American Hardware Manufacturers Association recently in Atlantic City, N. J. He explained how the Rockford Club — the parent body—came to be organized in October, 1932, and how its success led to various requests for information on organizing similar clubs elsewhere. In this way it became evident that a national organization was needed in the home workshop field, and the Guild was accordingly incorporated on a strictly noncommercial and nonprofit basis.

Mr. Ryder illustrated his talk with a number of slides he had himself prepared. These showed graphically the growth and spread of clubs by months and by location, the civic projects which clubs have worked out, the types of local exhibitions held by the various clubs, typical meetings and demonstrations, and a number of individual projects.

A gavel was presented by Mr. Ryder in behalf of the Guild to the president of the Hardware Association. This was accompanied by a perfect replica of the gavel in miniature, about 1¼ in. long, for the president to keep as a souvenir when he retires from office.

Several clubs in the Guild have displayed commendable energy and initiative in helping organize other clubs in nearby localities. Nothing will help promote the Guild idea better than this type of effort. When the club members have friends in neighboring towns who would like to start a club, it is suggested that the officers of the club or a delegation of members volunteer to aid in the work of organizing the new club. Those interested in the new club can also be invited to attend a meeting of the already established club so as to familiarize themselves with the procedure.

An attempt was made recently to use the name and prestige of the Guild in a selling scheme. It goes without saying that if any member of any club is approached either by an agent or by mail in this way, he should report the matter at once to Guild headquarters. The Guild is entirely noncommercial, disinterested, and impartial, and it will countenance nothing of this kind.

Ingenious efforts of various varieties have been made, of course, to obtain lists of the club members from the Guild in order to solicit business from them. The Guild has refused all these requests. Not a single list, in fact, has been permitted to reach any outside source. The wisdom of this policy has now become so obvious that local clubs should be careful to follow the example of Guild headquarters.

ADVISORY COUNCIL

•

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Capt. E. Armitage McCann
Founder, Ship Model Maker's Club

Dr. Francis G. Pease
Astronomer, Mt. Wilson Observatory

Frank A. Vanderlip
Banker and Publicist, New York

New Clubs Formed

Atlanta Homecraft Club, Atlanta, Ga.
Central Y Homeworkshop Club, Rochester, N. Y.
Charlotte Homeworkshop Club, Charlotte, N. C.
East Bay Homecrafters Club, Oakland, Calif.
Iroquois Homeworkshop Club, West Springfield, Mass.
Lowell Homeworkshop Club, Lowell, Mass.
Middletown Homeworkshop Club, Middletown, Conn.
Onondaga Homeworkshop Club, Syracuse, N. Y.
Patchogue Model & Hobby Club, Patchogue, Long Island, N. Y.
San Diego Homecraft Club, San Diego, Calif.
St. Joseph Homeworkshop Club, St. Joseph, Mo.
Springfield Homecraft Club, Springfield, Mass.
Twentieth Fleet Division, U. S. Naval Reserve Homeworkshop Club, Bridgeport, Conn.

WHAT CLUBS ARE DOING

A pledge to have at least 750 toys ready for distribution among needy children before Christmas has been made by the newly organized San Diego Homecraft Club of San Diego, Calif. The first meeting of the club was attended by thirteen men, and eight new members joined at the second meeting. Charles B. Wincote, the secretary-treasurer, reports that a membership of sixty or more is anticipated. C. A. Pease is president, and R. H. Gunness, vice president. Instructive talks and demonstrations have been given before the club on wood staining, gluing, and wood turning. Samples of the Christmas toys were submitted by J. R. Fisher and Ross D. Wilson, the designs adopted being a shovel, wobby duck, novelty walking toy, twin penguins, sausage dog, cradle, doll bed, and pile driver.

The new Creston Homeworkshop Club of Creston, Iowa, is holding well-attended meetings in the home workshop of Dr. A. Fred Watts. Guy Perry is president of the club. A chalk talk was recently given by C. N. Scott, a manual training teacher who is vice president, on furniture design.

"Our local club," writes Dr. Howard G. Beatty, the secretary and treasurer, "wishes to extend to the Guild, and to POPULAR SCIENCE MONTHLY, its most sincere thanks for fostering such a worth while organization. In no other way could the home workshop movement become so widespread and successful."

The Topeka Homeworkshop Club of Topeka, Kans., has awarded the Popular Science silver medal to C. J. Boeger, a photographer, for the best piece of craftwork displayed at the exhibit staged by the club at the Kansas Free Fair. The decision was based on the popular vote of visitors. An inlaid table made by Dr. S. T. Millard gained a larger vote, but could not qualify for the special craftwork award because it *(Continued on page 85)*

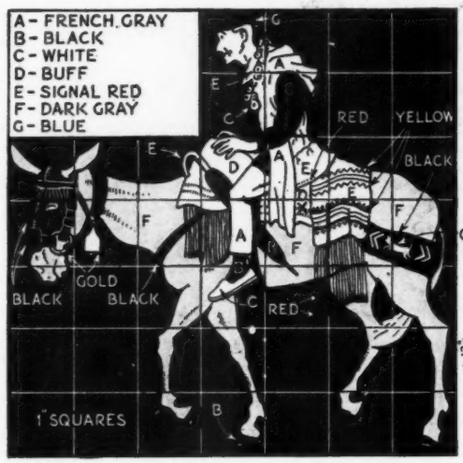
WITH 119 CLUBS ALREADY ORGANIZED, THE NATIONAL HOMEWORKSHOP GUILD GROWS STEADILY IN MEMBERSHIP

Peasant on Muleback

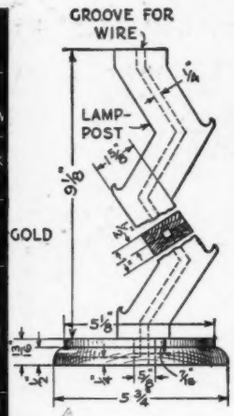
Ornaments Unique Little Table Lamp

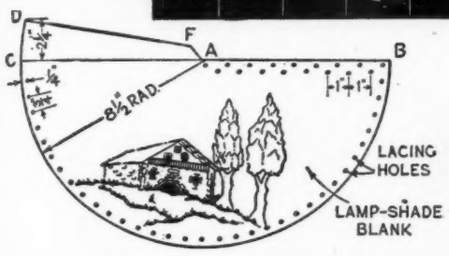
By Luis Gurrea

MADRID, SPAIN



How to lay out the figure and a suggested color scheme; and, extreme right, the lamp base and lamp-post





A pattern for the shade with an appropriate landscape design, which is painted on in brown tones

This easily constructed lamp has a decorative quality that places it in a class by itself

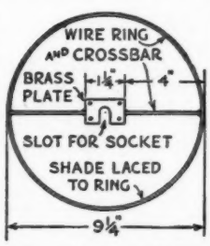
THIS original table lamp represents a Basque peasant riding a mule to market. Its construction is well within the ability of any woodcrafter.

Draw the design full size and transfer it with carbon paper to a block of wood ¾ by 7 by 7 in., the grain of the wood running up and down the figure. Any soft carving wood will do. Cut the profile out with a jig saw or coping saw and trim with a sharp jackknife or chisel. Round the edges of the figure and mark the outline of the man's legs, umbrella, saddle, blanket, and harness. This is done with vertical cuts and worked out with slanting cuts toward the vertical cuts.

With the outlines marked, proceed to carve the figure. The man's leg and shoe are left in high relief. The harness is raised only a little above the body of the mule. The mule's head is reduced to about ⅝ in. thick, and the harness, eyes, and mouth left just a little in relief. The neck at the point nearest the head is reduced to ½ in. thick and is tapered to the body. The head of the man is about ⅝ in. thick. He has a handkerchief and a string of garlics around his neck.

The front and hind legs of the mule on the right side are next cut down to a depth of 7/16 in., and the left legs are similarly carved, but from the opposite side. This work should be done with razor-sharp tools. Round the edges of the legs with the exception of the joints and hoofs.

Give the pommel or front of the saddle a conical shape, round on top, and have its lower edge about 1/32 in. higher than the body of the mule itself.



How the lamp-shade support is assembled

The left ear is cut down to about 5/16 in.; likewise the right ear, but from the opposite side. Round the edges of the ears very carefully.

The other side of the design is exactly the same, but without the umbrella. (For helpful instructions in wood carving, see P.S.M., Apr. '33, p. 73.)

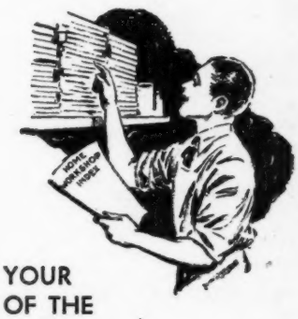
The base of the lamp is turned from a block 13/16 thick. A hole is made in the center ⅝ in. in diameter and 7/16 in. deep. If a lathe is not available, the base can be made square or hexagonal with an appropriate molding.

The lamp-post is made from two pieces ½ by 4 by 10 in. These are glued together with a piece of paper between, and the design is drawn and cut out. Then the two parts are separated, and a groove ⅛ in. deep and ¼ in. wide is cut in the middle inside face of both sides, following the zigzag shape. The lamp cord is inserted and the two parts are glued together. The lamp-post and base are then assembled with glue. The lower end of the wire, of course, should pass through the base, for which purpose a groove must be made underneath. Glue the wire in place and cover it with a plastic wood composition. The lamp stand is lacquered sky blue, signal red, navy green, or any desired color.

The left side of the figure is then painted with oil colors according to the color chart. Once the paint is dry and before going any further, attach the figure to the lamp-post with a screw. Countersink the screw, cover it with plastic wood composition, sandpaper smooth, and proceed with the painting.

With tinned stiff wire about 3/32 in. in diameter, make a hoop 9¼ in. in diameter and two crosspieces, each 4 in. long. Solder as shown with a brass or tin plate at the center. This is nailed to the lamp post to hold the shade.

On a piece of lamp-shade paper, draw a semicircle with an 8½-in. radius and prolong the circumference on one side about 2¼ in. Paint the design with burnt umber oil paint. Punch 5/32-in. holes all around the circumference, spaced ¾ in. apart and ¼ in. from the edge. The double row of holes going from the vertex to the base of the shade are 1 in. apart, and the rows are ⅜ in. apart, with the holes in one row ½ in. higher than those in the other row. When forming the cone, line *AB* should coincide with line *AC*, therefore the holes in portion *ACDF* should be made to coincide with those on the other side. With lacing of leather or imitation leather, join the shade from the vertex down to the base and continue around the border.



GET YOUR COPY OF THE

1934 Home Workshop INDEX

OUR Home Workshop Annual Index for 1934 is now ready. To obtain a copy, it is not necessary to fill out a coupon or write a letter. Merely address Popular Science Home Workshop Index, 381 Fourth Avenue, New York, N. Y., and inclose ten cents together with a plain return envelope addressed to yourself. Do not put a stamp on the return envelope which you inclose; we will pay the postage when we mail the Index to you.

The Index is a complete alphabetical list of all the articles published in Popular Science Monthly during 1934 in reference to woodworking, craftwork, shop methods, house repairs and short cuts, boats, model making, radio, automobiles, electrical apparatus, and such hobbies as photography, chemistry, microscopy, and astronomy. Provided you have kept the issues of 1934, the Index is the one thing needed to enable you to find what you want when you want it. Without the Index, that is a difficult task, because there are almost 400 pages of this type of information in one year's magazine—a gold mine of permanently useful material.

MONTH'S BEST AUTO IDEAS

Ingenious Methods Found by Our Readers to Solve Common Problems in Cars

Mirror Hung in Garage Is Handy in Many Ways

IN MY garage I have a large mirror salvaged from the attic and hung on the rear wall. When I drive in or out, it helps me to keep the car in the center, away from the walls. At night, it gives me a quick check on my headlights, and when I work on the light wiring, it does away with the necessity of running around to the front of the car every time I try to make a faulty headlight work. The mirror is the handiest addition I have made to my garage in recent years. I am always finding new uses for it in working on the car by night or day.—J. C.

Built-In Trouble Light

A HANDY trouble light can be made from a spare headlight lamp, any bayonet-type socket, a few feet of wire, and an ordinary battery clip. First, connect two short lengths of wire to the socket. Bare one wire for two or three inches and to the other fasten the spring clip. Then wrap the bare wire around one radiator stay to serve as a ground, hang the socket on the same stay, and screw in a bulb to complete the job. To use the light, simply snap the battery clip onto the terminal at the top of the starter motor to complete the circuit. This eliminates the clumsy length of wire that forms a part of most trouble lights, and the trouble of mounting a socket and switch on the cowl wall.—R. W.

Lifting Heavy Wheels

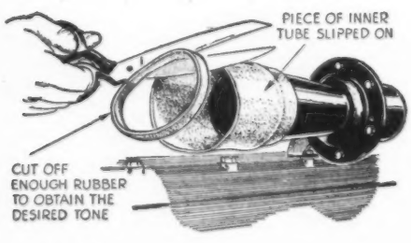
LIFTING a wheel into place on a jacked-up axle is not always an easy task, especially if the tire is heavy. However, if you have a modern screw jack, you can use its folding handle as a lever to lighten the work. Simply open the joint a few inches, place the opened ends under the tire, and lift up. You'll be surprised how easily the wheel will slip into place. The drawing below shows how the handle is placed. —W. C.

Breaker Point Dresser

RECENTLY when my car failed to start and inspection showed that the breaker points needed cleaning, I found that my tool kit lacked a thin file as well as emery cloth. When I was about to give up, I spied a safety-match box on my bench. Folding the box flat to expose the abrasive strip, I went to work on the points. In a few minutes I had done a professional cleaning job and my car started without further trouble.—C. E. P.

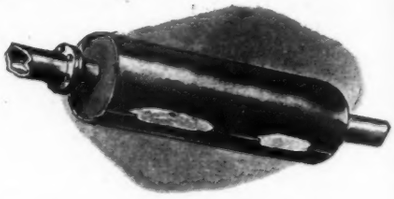
Fixing A Noisy Muffler

WHEN a muffler suddenly becomes noisy, nine times out of ten it is due to open seams in the casing caused by vibration or a backfire. Generally, it can be quieted by sealing the leaky seams with ordinary asbestos furnace cement. Mix the cement to a paste and spread it on, making sure that it sinks into the openings. The open seams can be found easily by their soot-blackened appearance. Since it resists heat, the cement will not be loosened by the exhaust fumes.—C. A. I.



Changing Horn's Tone

CAR owners who dislike the sound of their car's horn can change its tone by slipping a length of inner tubing over the end. It is best to start with a section about a foot long, clipping off an inch at a time, as shown at left, until just the right note is obtained. The tube lengthens the sounding horn.—H. A.



Asbestos furnace cement, spread on the seams of a noisy muffler, will silence it effectually

ACROSS HIS DESK flows the news of the world: Ray Baker of International News Service. Telegraph wires . . . cables from foreign countries . . . flash 100,000 words a day to Baker . . . to be quickly judged and edited.

Copyright, 1934, R. J. Reynolds Tobacco Company

PERSONAL EXPERIENCES THAT POINT THE WAY TO INCREASED ENERGY!

Newspaper man—hockey star—business woman—wherever smokers are placed in life, they notice a positive energy-refreshing effect from smoking Camels when they are tired or "out of sorts."

As Ray Baker says regarding his own experience: "The man on the INS news desk has a high-pressure job.

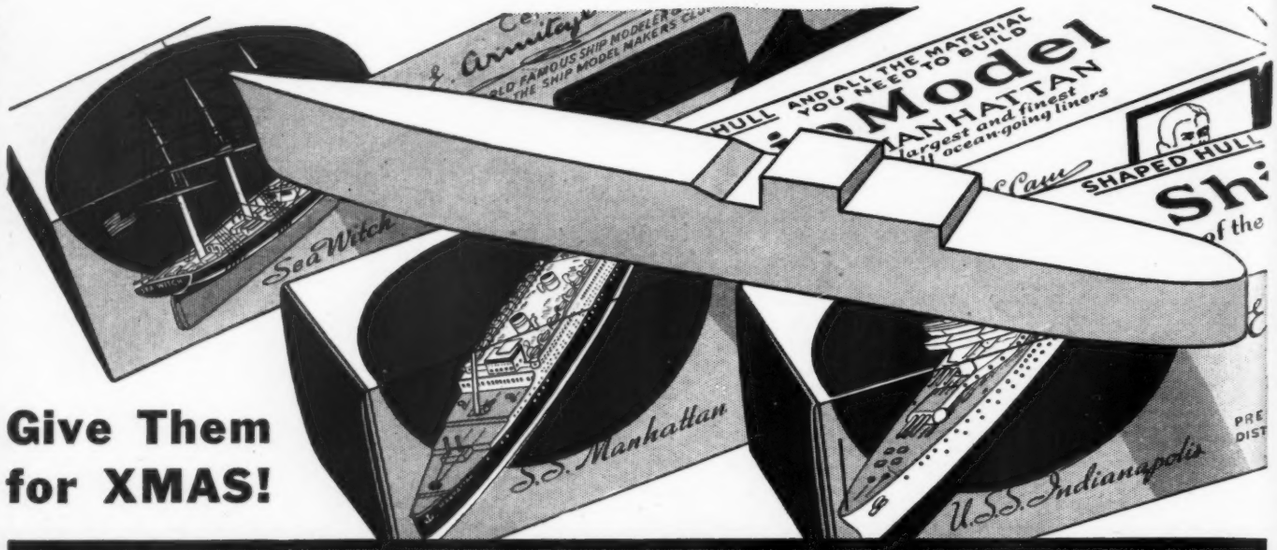
"Whenever I feel 'all in' Camels bring back my pep, and I can tackle the next story with renewed energy! For over ten years I've preferred Camels. They have a rich, distinctive flavor that just suits me. And I can smoke Camels continually without jangled nerves."

Science confirms the experience of smokers regarding Camel's "energizing effect." You can smoke them freely since Camel's matchless blend of costlier tobaccos never upsets the nerves!

HOCKEY STAR. "Bill" Cook says: "I smoke only Camels. Their taste sure hits the spot! I smoke a lot and I find that Camels never get on my nerves or tire my taste."

BUSINESS GIRL. Eve L. Miller says: "I started to smoke Camels because I appreciate mildness and delicacy of flavor, and Camels give me a 'lift' when my energy is low."

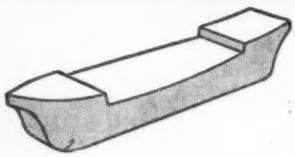
Camel's costlier Tobaccos never get on your Nerves!



Give Them for XMAS!

BUILD YOUR OWN SHIP MODEL

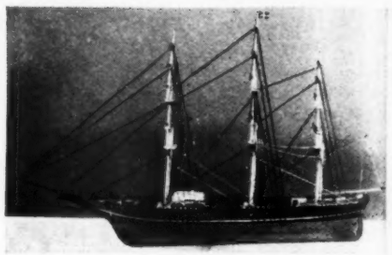
With These New, Improved, Simplified Shaped-Hull Kits

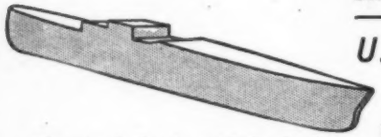


Sugar pine shaped hull—main cuts already made. Easy to finish. Top printed for location of masts, deck houses, etc.

Clipper Ship "Sea Witch" **$1.50** Postpaid

13 inches long—8 inches high. Famous and beautiful American Clipper. Kit contains every part needed including blue print, and pamphlet of instructions. Top deck of shaped hull stamped for location of masts, houses, etc. Kit contains paints, glue, chain, deadeyes, anchors, flags, printed bow and stern name plates. $1.50 delivered.

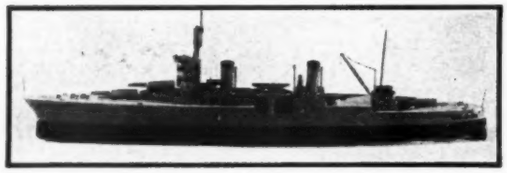


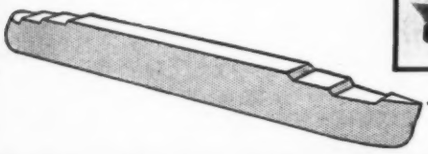


Almost wholly shaped hull of soft sugar pine with all main cuts already made, easy to finish.

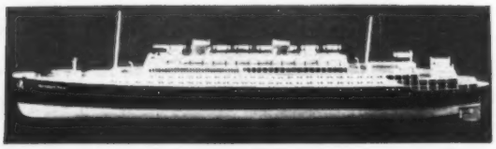
U. S. S. Indianapolis - - - **$1.50** Postpaid

Complete Kit for 12 inch model of the famous cruiser from which Pres. Roosevelt viewed the fleet. An excellent, graceful, racy model, easy to make with simple hand tools. Kit contains everything needed including paints, glue, anchors, propellers, rudder, blue print, pamphlet of step-by-step instructions, etc. $1.50 postpaid.





S. S. Manhattan - - - - - **$1.00** Postpaid



Everything you need to make a 12 inch model of this largest and finest American built liner. A sharp pocket knife is practically the only tool you need. Kit contains paints, glue, blue print, pamphlet of instructions, 40 completely finished life-boat davits, 2 propellers, 2 anchors, 1 rudder. All main cuts in the sugar pine hull already made.

DEALERS!

Write for Terms on These Attractively Packaged New Kits

Model Makers USE THIS COUPON →

Fill out and mail this coupon together with remittance, and the complete Kit or Kits you want will be shipped immediately, delivery paid by us.

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Send me *prepaid* the Kit or Kits checked below, for which I enclose payment.

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☐ INDIANAPOLIS	1.50 Postpaid
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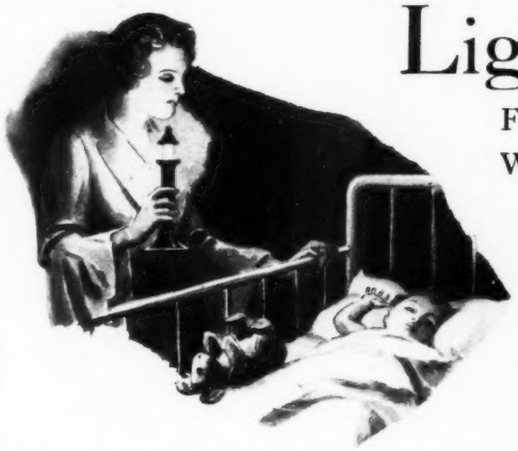
Night Lamp *in form of* Lighthouse

FLASHES ON WHEN LIFTED



This is a good bedside lamp for emergency use because the act of lifting it automatically switches on the light

By Herman Hjorth

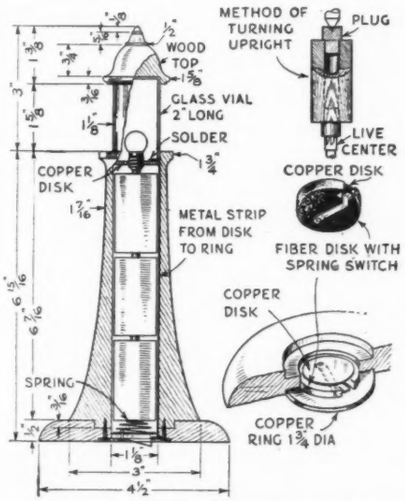
A NOVEL automatic night light that flashes on when lifted may be made in the shape of a lighthouse model, as illustrated. The body and base are of wood, and the design may be varied so that the flash light will be a miniature copy of any particular lighthouse with which the builder may be familiar.

Bore a 1⅛-in. hole through the endwood of a 3 by 3 by 6⅝ in. piece of whitewood or other softwood, using an expansive bit. Turn and fit plugs into each end, and turn the stock. The lower part must have a projection to fit into a corresponding recess in the base. Turn the base from a piece ½ by 4½ by 4½ in.

The flash-light bulb is fitted and soldered into a copper or brass disk, which must be firmly wedged in the 1⅛-in. hole about ¼ in. from its upper end. The lower end is provided with an automatic spring switch made from a piece of fiber or hard rubber and a piece of spring brass. A copper or brass disk, a little smaller in diameter, covers its upper surface and is riveted to the piece of spring brass. The switch is held in place by a copper or brass ring screwed to the underside of the base. A wire or metal strip connects the upper copper disk and the copper ring, being soldered to both. A spring such as is used in ordinary flash lights presses the dry cells against the underside of the bulb and makes the connection between them and the spring switch. When the switch touches the copper ring upon lifting the lighthouse, the circuit is closed and the bulb lights.

The upper part consists of a capsule vial of glass 1⅛ in. in diameter and 2 in. long, which can be obtained in most drug stores. The top is turned from a piece of wood 1⅝ in. thick, 1⅝ in. wide, and 1⅜ in. long, which is recessed to fit snugly over the inverted vial. Paint this recess and the copper disk white, and finish the exterior as desired with enamel or lacquer.

If a lathe is not available, the case of an old flash light may be used as the body of the lighthouse, and the base and top part may be modified to suit whatever materials are on hand, as described in a previous article on a similar type of night light (P. S. M., Oct. '32, p. 65).



A cross section of the lighthouse lamp, how the body is turned, and details of the switch

NOVEL GIFT SEWING KIT IN PELICAN DESIGN

IF YOU still have some last-minute gifts to make, here is a unique idea for a sewing kit. It is in the form of a pelican mounted on a turned wooden box. To save time, a suitable box may be purchased, or an ornamental turned block could be substituted. The bill of the pelican is formed by a pair of scissors, and its back is upholstered to serve as a pincushion.

The bird is cut with a coping saw or jig saw from three pieces of wood, the two outside ones being ⅜ by 5¾ by 5¾ in., and the center one, ¼ by 4¼ by 5¾ in. The grain of the outer pieces should run up and down; that of the middle piece, horizontally. The outline of the mid- *(Continued on page 83)*

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AND WHAT IT MEANS
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For years and years, America's finest furniture and automobile bodies have been built with Keystone *Pure Hide* Glue. The strength is there to stay!

This same superior *Pure Hide* Glue is now available to all Homecrafters in convenient packages and cans. Have the satisfaction of building a piece of furniture that you *know* will be as solid in twenty years as it is a month from now. See below.

Special Offer

With each order for standard 25c. can (Liquid) or 25c. box (Dry) of Keystone *Pure Hide* Glue we will send you, postpaid, a FREE copy of the new GLUE HANDBOOK shown above, containing over 70 pages of valuable information concerning the History, Manufacture, and Correct Use of Glue.

In ordering, send stamps or money order, *not cash.*

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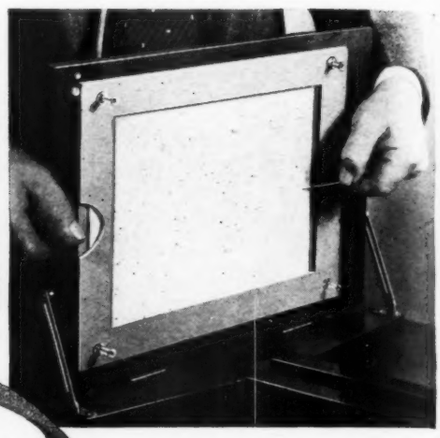
WILLIAMSPORT, PA.

SPEEDIER WAYS TO MAKE

Photo Enlargements

By Frederick D. Ryder, Jr.

Homemade bromide paper holder fastened on a vertical enlarging easel with thumb tacks. The holder consists of a cardboard backpiece, a spacer, and a masking frame



A pin is used to push the paper into the waiting fingers of the other hand. *At left:* Centering a small negative with the aid of a mask of black and white paper

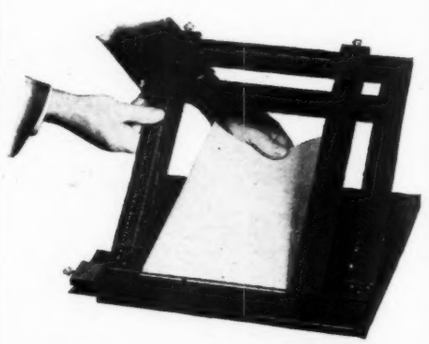
IF YOU figure out how you spend your time when you are making photographic enlargements, you will find that far too much of it is wasted in getting the paper properly masked and in the right position to include the portion of the negative you wish to enlarge.

Of course, when you set out to get the best possible enlargement from an especially good negative, you do not mind how long it takes to try different papers with all sorts of odd dimensions for the masking, but if you are like the average amateur photographer, what you want most is the simplest possible way to get large prints from your negatives without wasting any more time than necessary. Furthermore, you probably prefer to make the majority of your enlargements to some definite size. For most purposes, two fixed-size paper holders are sufficient.

An ideal paper holder should keep the paper flat, should be so arranged that the paper can quickly be slipped into place, should automatically mask off the edge to form a clean-cut, white margin, and should be easily held in place on either a horizontal or a vertical easel. Finally, it must be convenient to move and turn to any angle.

In theory, the only way you can hold paper absolutely flat is to place it on a flat surface and cover it with a sheet of glass. In practice, the glass may be eliminated if the paper is held against a flat surface all around its edges. Our paper holder therefore must have a flat surface for a back and a rim to hold the four edges of the paper.

Factory-built adjustable paper holders are, of course, obtainable. A unit of this type will cost from seven to ten dollars, depending on the style and make. These units are purposely made heavy so that they will stay in *(Continued on page 82)*



Any size enlargement from 8 by 10 in. down can be masked instantly with this adjustable holder

$50 *for Christmas Photos*

NO AMATEUR photographer has far to look for interesting subjects at Christmas. They are all around him. Everything connected with the Yuletide season, from wrapping up the gifts to tucking the tired children in bed late on Christmas Day with their toys all around them, lends itself to striking photographic treatment. The fact that many of these pictures must be taken indoors is now no handicap. Photoflash and photoflood bulbs, together with modern high-speed films, have made it easy to take such views without danger of failure.

See what you can do this Christmas, and enter your best prints in our new contest. The prizes will be as follows:

FIRST PRIZE	$25
SECOND PRIZE	15
THIRD PRIZE	5
FIVE PRIZES, $1 each	5

Mark your entry "January Photo Contest" and mail it to the Photographic Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, not later than February 1, 1935. It is not necessary to send the films.

Write on the back of each print your name and address and what type of lighting was used—daylight, photoflash bulbs, photoflood lamps, or other artificial illumination. No prints will be returned unless a self-addressed, stamped envelope is inclosed. The contest is open to any *amateur* photographer except employees of POPULAR SCIENCE MONTHLY and their families. The developing and printing, of course, may be done by a professional. In case of ties, each tying contestant will be awarded the prize tied for.

FOR CHRISTMAS

GIVE YOURSELF THIS NEW GENERAL ELECTRIC COMPLETE WORKSHOP

No belts • No pulleys • Six machines in one, instantly interchangeable • Nothing else to buy

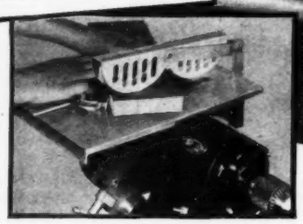
Never before have so many practical working features been included in a motorized workshop. Every attachment is driven *directly* from the G-E motor. No frictional power losses or vibration to interfere with accurate work. Compact but sturdy, reinforced steel cabinet gives firm support.

SIX MACHINES IN ONE

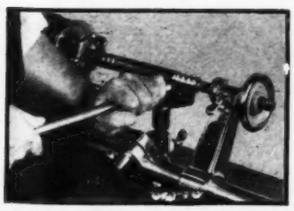
(1) Circular saw with all adjustments, (2) Jig saw, (3) Sabre saw for wood and metal work, (4) Nine-inch lathe and two wood-working tools, (5) Eight-inch sander and sanding table, (6) Drill chuck with set of nine drills. General Electric quality throughout.

See It At Your G-E Refrigerator Dealer's

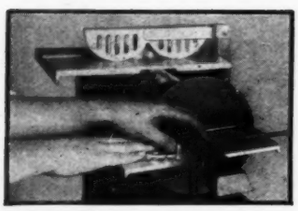
COMBINATION SABRE AND JIG SAW, for wood or metal. Table tilts 45°. Self-aligning overhead arm quickly secured by single bolt. Saw chuck holds machine files with round shanks up to ¼-inch diameter, greatly increasing wide scope of machine. Sabre saw can be attached in 6 seconds.



CIRCULAR SAW 8″ diameter, direct motor driven; tilting table, 10″ x 14⅜″, easily set for depth of cut and for any bevel up to 45°; adjustable protractor and mitre gauge; self-squaring rip guide with table calibrated in inches, front and rear; self-setting safety-guard.



LATHE swings work up to 9″ diameter, turning lengths, with extension, up to 30″. The face plate, fitted with removable cone and spur centers, screws directly on motor shaft, or is carried on special mandrel held in chuck.



SANDER TABLE is grooved for the mitre gauge and rip guide of the saw and is slotted for metal cutting saws or milling cutters. The 8-inch sanding disc screws directly on motor shaft or is carried by the arbor held in chuck.

QUICK CHANGE ATTACHMENT CLAMP makes the attachment of the sanding table, sabre or jig saw and tool post a matter of a few seconds. Construction is rigid and easily adjustable.

COMPLETE . . . ECONOMICAL . . . ACCURATE

YOU are through buying when you get this complete outfit. Motor, bench, and all tools come with it. Made for the professional or amateur woodworker, the small shop or the home craftsman. Equally efficient for all, because the vast resources of General Electric Company contributed to its painstaking development. Look at that motor. Though compact, it is a high-efficiency ball-bearing motor with ¾″ shaft reduced to ⅝″ at the bearings. It gives continuous flow of power always at the cutting edge because of the powerful torque and inertia of its armature.

Surprisingly low current consumption cuts down operating cost to a level never before achieved.

Imagine—a complete power workshop which takes a floor space of only 18 by 38 inches! When you see it demonstrated—at your nearest G-E refrigerator dealer's—you will marvel at its completeness, its all-round efficiency, its practical working features, its ruggedness—and, with all these things, its amazingly low price.

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Motor
Bench
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GENERAL ELECTRIC

For those all-important

FINISHING TOUCHES

Not for a minute would we belittle the skill and effort it takes to turn out a stool like the one at the left. *But* it is still a plain, unfinished piece of furniture—you wouldn't feel very proud of it.

On the other hand this same stool can be beautifully inlaid, an attractive corner bead put on the edges, and the aprons rounded over—all with a Stanley Electric Router-Shaper.

Corner beading, dovetails, inlaying, dado, rabbet and molding cuts — these are typical of the hundreds of woodworking operations that can be handled easily with this inexpensive home workshop outfit.

Don't be satisfied with plain, unfinished work. Write for this catalog which describes the Router-Shaper and shows what it will do.

THE STANLEY ELECTRIC TOOL CO.
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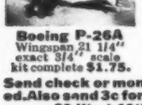
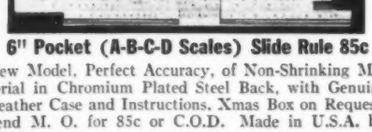
MOVABLE CONTROLS OPERATED FROM COCKPIT
DESIGNED FOR YOU BY FLYING MEN

You'd like an experienced flyer to help you lay out a plane with controls that work elevator, rudder and ailerons from the cockpit. That's what IDEAL does! Experienced flyers who have spent their lives designing and flying planes have laid out these big, beautiful flying models. **That's why you learn aviation principles building planes the IDEAL way.** That's why IDEAL planes are absolutely accurate 100 percent scale models—perfect, complete in every detail. Also includes bright, high lustre finish and many other exclusive Super-Detail fittings.



Boeing P-26A
Wingspan 21 1/4" exact 3/4" scale
kit complete **$1.75.**

Send check or money order today for the plane pictured. Also send 3c for folder showing latest model planes.
28 West 19th Street, New York City, N. Y.
IDEAL AEROPLANE & SUPPLY CO., INC.



6" Pocket (A-B-C-D Scales) Slide Rule 85c

New Model, Perfect Accuracy, of Non-Shrinking Material in Chromium Plated Steel Back, with Genuine Leather Case and Instructions. Xmas Box on Request. Send M. O. for 85c or C.O.D. Made in U.S.A. by INDECO RULES, 239 John Street, Bridgeport, Conn.

HOW TO MAKE PHOTO ENLARGEMENTS

(Continued from page 78)

place on a horizontal easel without fastening them down; in consequence, it would be difficult to use such a paper holder on a vertical easel except by fastening it permanently in one position. If you have a vertical enlarger and expect to do a lot of enlarging with frequent changes of paper size and much masking to odd shapes, the expense of a unit like this is warranted.

As, however, most amateurs want to enlarge only to one or two standard sizes, simple, homemade paper holders will give practically as good service. Moreover, being far lighter, they are much more practical for use on a vertical easel.

If you are building the holders for use on a horizontal easel, the base can be a heavy piece of wood to give weight; otherwise heavy cardboard will serve. Whether of wood or cardboard, cut the base 2 in. longer and wider than the rated size of the paper it is to hold.

Cut the second piece from cardboard to match the first in outline. Then, with a sharp knife, cut a rectangular opening in it 1/16 in. wider than the sheet of paper. Get your measurements for this opening directly from a piece of the sensitive paper. Carry the lengthwise cuts clear through one end of the cardboard so that you finish with a U-shaped piece.

Now take another piece of cardboard and, after cutting its outside dimensions to match the other two pieces, sharpen your knife and cut a rectangular opening in length and width equal to the actual dimensions of the paper less, in each case, twice the width of the white margin you desire around the picture area.

If you fit the three pieces together so that the outer edges match, you will see that you have formed a framework into which the bromide paper can be slipped by way of the open end of the U-shaped piece. A circular notch should be cut, as shown, in the end that is to be placed over the open end of the U-shaped piece. Make it just deep enough so that its edge will cover the end of the paper when pushed all the way in. This notch makes possible the insertion of the paper without bending the top cardboard.

Cement the three pieces together thoroughly. If the cardboard is of the soft, spongy kind, give it a coat of well thinned shellac after the cement has completely set.

One of these cardboard paper holders is shown in use on a vertical easel, held with thumb tacks.

WHILE the circular notch permits the paper to be pushed into position for the exposure, you can't pull it out the same way without bending up the cardboard. Removing the paper is accomplished with ease, however, with the aid of a strong pin as shown in another illustration. Press the point of the pin lightly against the sensitive surface of the bromide paper at the extreme edge opposite the opening and push it out far enough so the end may be grasped by the waiting fingers of the other hand.

While these cardboard paper holders will, if carefully constructed, give long service, they must be handled with care to prevent accidental damage. Those of our readers who have home workshops will find it easy to carry out the same design in wood or sheet metal, hinging the end to eliminate the need for a circular notch and the use of a pin.

A suitable paper holder eliminates most of the time ordinarily wasted in using any of the modern vertical enlargers designed for miniature negatives because these outfits have arrangements for quickly shifting from one negative to the next. Much time is lost, however, in changing miniature negatives in any universal type enlarger that handles all popular sizes of amateur negatives.

What is needed is a guide that will show you how to place the negative in the same position between the glasses each time. As it is good practice, in any case, to cut off all the extra light that would otherwise go through the large negative opening when a small negaive is in place, the simplest solution is to take two pieces of paper, one white and the other black, and cement them together, cutting them to make a snug fit in the negative holder. Next cut a rectangular opening just a trifle smaller in both directions than the size of the image on the negative.

Place the paper mask on the glass in the negative holder with the black side down so that the negative will stand out against the white side, and you will find it easy to set a negative correctly over the opening and drop the other glass in place to hold it in that position, as shown.

If you happen to have a universal type enlarger and use a miniature camera and, at the same time, are in the habit of making relatively small enlargements, say to 4 by 5 in., there is another trick that will save you time. Instead of making your enlargements one at a time, put cross pieces over your 8 by 10 in. paper holder so as to mask the large sheet into four equal rectangles. Next cut a mask for your negative carrier like the one just described, but with four openings to correspond with the masking of the paper holder. By sorting your negatives into groups of equal density and trimming away some of the surplus film outside the picture area, you will find it easy to make four enlargements at a time.

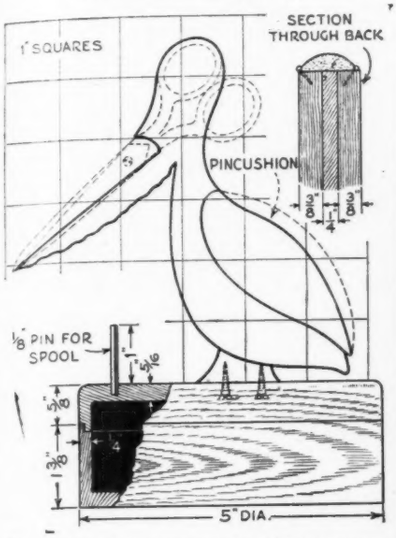
Using Sunlight *for* Indoor Portraits

WITH fast film and high-speed lenses it is entirely practical to take indoor pictures of difficult subjects such as babies or small children. If, however, you place the subject in the sunlight streaming through a window, as you have probably discovered for yourself if you ever tried it, you get a harsh, soot-and-whitewash sort of effect that is most unpleasant.

The trick is to use white paper as a reflector to throw light on the portions not in direct sunlight. The reflector, too, should be in the direct sunlight to be really effective. The accompanying picture was made by this method. The girl simply held a paper which reflected the sunlight coming over her shoulder.

NOVEL GIFT SEWING KIT

(Continued from page 77)



The sewing kit. To lay out the bird full size, draw 1-in. squares and copy from point to point

dle piece follows the lower edge of the scissors. The three pieces are glued together and, when dry, filed and sanded to shape.

The box is turned in the usual way (see P. S. M., July '34, p. 86). About six ⅛-in. dowels or brass pins are fastened in a circle to the lid as shown. These are for the spools most frequently used. The pelican is finally fastened to the center of the lid.

HOW TO PREPARE PHOTOS FOR USE ON CRAFTWORK

ANY kind of craftwork of light color and smooth surface may be ornamented with genuine photographs, either singly or grouped to form a design.

The selected negatives are first printed on slow plates in the same manner that prints would be made on paper. After they are developed and dried, they will form positive pictures on glass. These are bathed for half a minute in the following solution: To 12 oz. of water add, in the order given, ½ oz. potassium carbonate; ¼ oz. pure glycerine; ¼ oz. formaldehyde, 40 percent strength.

The plates should then be drained and the excess solution removed with lintless blotting paper or chamois. After they are dry, use a knife or razor blade to cut through the film around the outside of each plate, ¼ in. from the edges. By inserting the blade edge under the gelatin film at one corner, it may be gently stripped off and kept in a book until used.

The gelatin films, which show the photographs in black against a transparent ground, are exceedingly thin. They should be trimmed to size with scissors while held between two sheets of writing paper, then applied to glass surfaces with a gum arabic solution, or to other surfaces with either white shellac or clear varnish. The entire surface should afterwards be given a coat of the shellac or varnish, which will effectively conceal the method used. The films may be colored or tinted with water color or oils, if desired, in the same manner that photographs on paper are treated.—GEORGE S. GREENE.

TESTING MOTORS BY SOUND

FAINT knocks or grinds in motors or gear boxes can be clearly heard if the mechanic places a flat steel scale or a metal rod between his teeth and rests the free end against work to be tested.—HAROLD C. BLAIR.

Make your own Christmas card with
G-E MAZDA PHOTO LAMPS

G-E MAZDA Photoflash lamp

G-E MAZDA Photoflood lamp

How this card was made! The tree was cut out of composition board, because a regular tree does not produce a simple silhouette. It was placed before a light colored wall with a G-E MAZDA Photo*flash* lamp behind it, directed at the wall. When the pose suited, the lamp was flashed. Another method is to put a sheet over a doorway behind the subjects and to flash the lamp in back of the sheet.

Christmas cards are easy to make . . . and loads of fun . . . thanks to G-E MAZDA Photo lamps.

These magic lamps open scores of possibilities for creating "different" cards . . . as well as for capturing happy moments the year 'round . . . through INDOOR PICTURES.

G-E MAZDA Photoflood lamps, used with supersensitive film, enable you to take dozens of pictures at night . . . SNAPSHOTS, if you use a camera with a fast F/6.3 (or faster) lens; TIME EXPOSURES of one or two seconds, with box or slow lens folding cameras. Excellent for taking home movies.

FOR BABIES, PETS and action scenes, you need G-E MAZDA Photo*flash* lamps. They make such pictures as easy as snapshots in sunlight. Use them anywhere (operate on batteries or house current) with any camera which can be set for "time." Each lamp gets one picture. 15 cents list.

Your druggist or camera dealer can supply you with lamps and film. General Electric Company, Nela Park, Cleveland, Ohio.

GENERAL ELECTRIC MAZDA PHOTO LAMPS

FREE FOLDER. "How to Snap Pictures at Night"... tells which lamp to use and where to put it... filled with helpful information. P.S.M.J-35

General Electric Company, Dept. 166, Nela Park, Cleveland, Ohio

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Address _____

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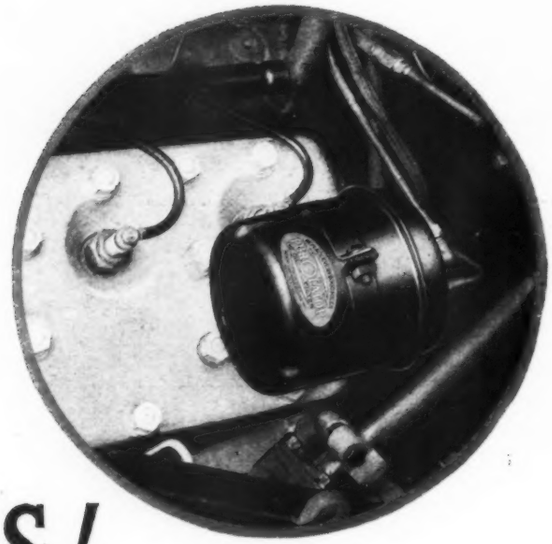


"YES!

FORDS AND CHEVROLETS CAN HAVE PUROLATOR PROTECTION"

This is in answer to the many inquiries that come to us from Ford and Chevrolet owners.

Fords and Chevrolets are not equipped with an oil filter at the factory . . . but your own service garage is now prepared to furnish and install a Purolator Oil Filter . . . *especially designed and engineered for these two jobs.*

AND YOU COULDN'T MAKE A BETTER INVESTMENT

If you are using a good grade of oil a *genuine* Purolator Filter will keep it so clean and effective you can safely lengthen the time between crank case drainings.

Your Purolator will catch and hold the dirt and grit and fine metal particles and hard carbon that settles in crank case oil . . . will keep these grinding, abrasive substances out of the oil stream and away from your engine . . . will lengthen its life and its smoothness of operation.

It is these destructive settlings that wear out bearings, score cylinder walls . . . cause costly repairs and replacements . . . send many a car to the junk heap, long before its time.

The economy, the long life and the satisfying smoothness of operation developed by the use of a Purolator Oil Filter is already known to millions of experienced motorists. For its use as original equipment is no longer confined to high-priced cars. Apart from these two makes, more than 70% of all cars sold in this country during the first six months of 1934 *left the factory equipped with a genuine Purolator* Oil Filter.

The cost of a complete Purolator Filter, especially designed for Ford and Chevrolet passenger cars or trucks and including all the necessary fittings, is only $5.00, plus a small charge for installation.

It will pay for itself many times over . . . both in actual dollar savings and in satisfaction.

If your own favorite service garage hasn't yet been supplied with this material, just clip and mail this coupon.

We will tell you how you can be promptly served, and will also send you an "Auto Almanac" . . . an unusual booklet . . . interesting and instructive.

MOTOR IMPROVEMENTS, INC.
Newark, New Jersey.

I am interested in a Purolator for
(check here) .....Ford .....Chevrolet

Send me without any obligation, further detail, together with a copy of "AUTO ALMANAC".

Name .....

Address .....

City ..... *State* .....

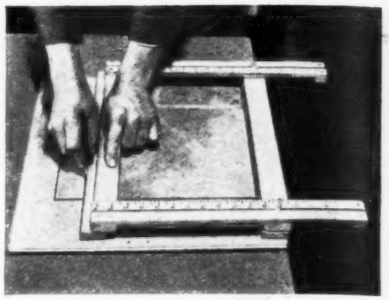
Note: Trucks and passenger cars take same model.

PUROLATOR

The Oil Filter on Your Motorcar

Licensed Under Sweetland Patents

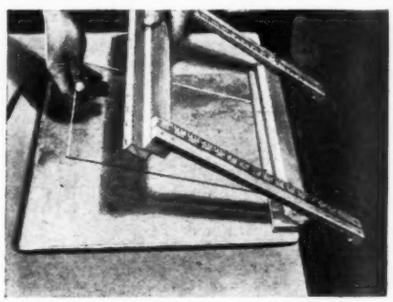
ADJUSTABLE CUTTING BOARD FOR GLASS



The adjustable straightedge is held firmly in place, thus assuring a straight, clean cut

A PIECE of ½ in. thick insulating board about 18 in. square with an adjustable straightedge as shown forms a convenient device for cutting small panes of glass. In making the guide, four pieces of wood ¾ by 1¾ by 18 in. and four pieces ½ by ¾ by 18 in. are needed. One piece of the heavier material is nailed to the base to serve as a backstop for the glass. To this is hinged another piece which holds the bolts with thumb nuts for adjusting the length of the guide strips. These strips are ruled off in inch and quarter-inch marks for convenience.

In use, the straightedge, which is nailed to the guide strips, is adjusted to the desired size and the thumb nuts are tightened. After the piece has been cut, the whole guide is lifted up, leaving the base clear for use in tapping and breaking the glass.—EMIL PEARSON.



The straightedge is hinged so that it may be lifted easily for placing or removing glass

COLORING BRASS AND COPPER

THERE is one really permanent color that may be applied to brass or copper. Although this requires quite a little work, it is well worth the effort.

Fill any wide-mouthed glass container not more than half full of commercial nitric acid, and put into this all the scrap copper that the acid will consume. Do this out of doors and be very careful not to get the acid on the hands or clothing. When the acid is ready, either dip the pieces to be colored into it, or coat thoroughly with a swab. Then heat them evenly until they take on, first a green, then a dark brown color. This is best done with a blowtorch, and the heat should be turned off the moment that the whole piece is brown.

Let the work cool, brush off the acid dust, and repeat. Sometimes three or four applications are necessary to obtain an even black. Finally, dust off, apply a good floor wax, and polish.

This finish surpasses any enamel and will not discolor. There is nothing that will affect it except fire or acid.

With hammered copper, the work should be gone over with jeweler's fine emery paper to bring out the copper high-lights before it is waxed and polished.—DICK HUTCHINSON.

HOMEWORKSHOP GUILD

(Continued from page 74)

had been completed before the club was organized. Mr. Boeger's project was a round tilting picture frame of vermilion wood. The club as a whole did not enter competition in the fair, but it was nevertheless awarded a special blue ribbon for merit. In open competition the members took seven first prizes and six second prizes. About 1,500 visitors a day for the six days of the fair saw the club's moving picture, which ran continuously. It showed the members of the club at work doing wood turning, hammered metal work, model ship building, photomicrography, welding, and show-card lettering. The Topeka Club has received as many as ten applications for membership at a single meeting.

METHODS of wood veneering were demonstrated by Guy H. Moore at a special meeting of the Bison Homeworkshop Guild, Buffalo, N. Y., recently, and at a later regular meeting Professor Hammonds gave an illustrated lecture on the pouring of the 200-in. lens for the new California Institute of Technology telescope. The club has been invited to use the clubrooms and facilities of the Buffalo Engineering Society in the Hotel Statler. In appreciation of this generous offer, the club invited the 400 members of the Engineering Society to attend one of its meetings in a body, and the invitation was accepted.

The Tucson Homeworkshop Guild of Tucson, Ariz., is now meeting regularly once a week. Permission has been obtained to use a public school manual training shop, when desired, at a small fee.

The Eugene Craftsman Guild of Eugene, Ore., has been offered the high school shop classroom for meetings whenever desired. This tender was made by Dr. O. N. Mickelson. An invitation has been accepted from Mrs. Ralph Pierce to visit Mr. Pierce's machine shop, where a demonstration will be given on the drill press, lathe, and stamping machine.

The Billings Homeworkshop Club of Billings, Mont., has outgrown its meeting place and is now planning either to rent one or construct a club building of its own. Its shop equipment was recently increased by a lathe, a circular saw, and a planer.

The Homecraft and Modelmakers' Guild of Richmond, Va., was given a display booth at the 1934 Virginia State Fair.

The Jacksonville Homeworkshop Club of Jacksonville, Fla., gives added interest to its meetings by awarding an attendance prize to the holder of the lucky number. As a club project, the members are constructing a cabinet to hold the magazines, books, and catalogs that are rapidly accumulating in the club library.

The Elizabeth Homeworkshop Guild of Elizabeth, N. J., is working on plans for an exhibit and also looking for a permanent home that will be convenient for carrying on its expanding program of activities.

Detailed information about the Guild and how to organize a club and obtain a charter will be sent to any reader who fills out the following coupon.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me this information in the large self-addressed and stamped envelope I am inclosing.

Name .....

Address .....

City..... State.....

(Please print very clearly)

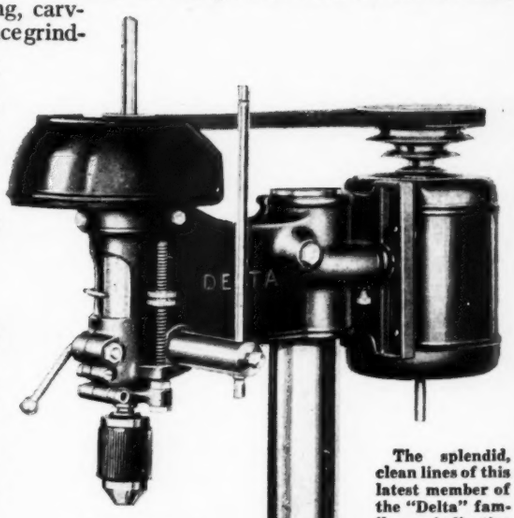
New Drill Press

New "DELTA" Models Now Complete Full Line of Modern Drill Presses

Two new "Slo-Speed" Drill Presses together with other models now makes available Delta Drills for every purpose—in home workshop and factory alike. A Delta Drill Press is almost a complete workshop in one tool. It can be used for mortising, routing, drilling, carving, sanding, shaping and surface grinding. Delta Drill Presses embody Delta "quality" throughout—and yet are priced at unusual low price levels. Send for catalog. See coupon below.

A Complete Line of Motor-Driven Woodworking Tools

"Delta" Woodworking Units are convenient, portable and compact. All are available in a large variety of combinations and at prices to fit all needs. The "Delta" line includes: Jointers, Band Saws, Scroll Saws, Circular Saws, Woodturning Lathes, Drill Presses, Boring, Routing, Sanding, and Mortising Attachments —and a full line of accessories.



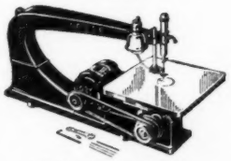
The splendid, clean lines of this latest member of the "Delta" family are indicative of the inner quality and good workmanship built into this "Delta" Drill Press.

You'll be astonished at the remarkably low price of this fine quality tool — one-third of the price at which machines of this calibre were offered.

New 6-Inch Jointer

Has new Patented Fence and many unusual improvements.

New Scroll Saw



Cuts with finest jeweler's blades at full motor speed. Many other features.

SEND FOR CATALOG

The 1935 catalog of Delta quality motor-driven tools is now off the press. It is crowded with photographs and information about the new line of 1935 Delta tools. It shows how Delta tools are built to stand the grind of production work, and yet are so low priced as to be within the reach of all.

Send coupon so your name will be placed on the mailing list to receive the 1935 Delta catalog without delay. Enclose only 10c at same time for Book of Practical Delta Projects. 32 pages of new and novel things to make, with many blue prints, working drawings, photographs and illustrations—and complete directions.

Delta Manufacturing Company
Dept. B135.
3775 N. Holton St. Milwaukee, Wis.

DELTA MANUFACTURING COMPANY
3775 N. Holton St., Milwaukee, Wis. Dept. B135

I enclose 10c (stamps or coin), for which please send me one copy of "Practical Delta Projects". Also place me on your mailing list to receive 1935 Delta catalog of quality motor-driven woodworking tools.

Name.....Age?.....

Address.....

City.....State.....

☐ Check here if you are a Delta user now.

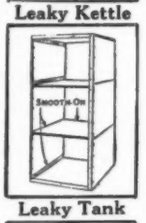
TAKE THE GRIEF OUT OF EMERGENCY REPAIRS

A sudden leak in the heating boiler—the hammer handle flies off—water squirts from a dent in the auto radiator—a drawer knob pulls out — screws strip from and loosen the door lock—a water pipe freezes and cracks — one caster won't stay in the table leg—your favorite pail starts to leak—a persistently loose nut puts the vacuum cleaner out of business—etc.—etc.

Radiator

Leaky Pail

Leaky Kettle



Leaky Tank

Stove Pipe

Oil Leaks

Possibilities like these are ever present to the householder, but invite no delays, repair bills or expensive new purchases if you have a copy of the Smooth-On Repair Instruction Book, keep a can of Smooth-On No. 1 on the shelf and like to prove yourself equal to the emergency.

Hundreds of repairs similar to the above are made quickly, easily and cheaply with Smooth-On No. 1, which stops leaks of steam, water, gas, oil, gasoline, smoke, etc., anchors loose screws, bolts, nuts, handles, machinery, etc., and holds equally well in metal, masonry, bath room tile, and wood.

Smooth-On No. 1 expands in hardening and when metallized holds as tightly as the metal to which it is attached. Power plant engineers, shop foremen and professional repair men prefer Smooth-On repairs because the simple cold application avoids fire risk and extra labor and a *dependable* finished job is ready in a hurry.

Send for the free booklet which also covers automobile repairs and shows dozens of simple money saving Smooth-On repair jobs. *Free if you return the coupon.*

Get Smooth-On No. 1 in 7-oz. or 1 or 5-lb. can from any hardware store.

Write for FREE BOOK

SMOOTH-ON MFG. CO.
Dept. 58.
574 Communipaw Ave.
Jersey City, N. J.

Please send the free Smooth-On Repair Book.

Name .....

Address .....

1-35 .....

Do it with SMOOTH-ON

METAL-WORKING LATHE

Complete with compound slide-rest, chucking device; 6" swing, 24" length overall, weight 22 lbs. Extra bed-lengths, 50c foot; attachments for wood-turning, milling, grinding, sawing, drilling, etc. at low prices. Send $1, shipped C. O. D. in U. S. balance plus express charges. **FREE, 96-page "American Homecrafters' Manual" with each machine.** Send 10c stamp or coin for sample copy "AMERICAN HOMECRAFTER" our how-to-make-it publication, and complete catalog of all machines including the "American Junior" complete line of **power tools at $2.50 each** (drill press, wood lathe, bench saw, shaper, sabre scroll saw, disc sander)—you can have a COMPLETE SHOP for only a few dollars—still time to order for Xmas.
AMERICAN MACHINE & TOOL CO., Dept. 38, 200 Broadway, New York

Plans *for* Last-Minute Christmas Gifts

YOU still have time to make a last-minute Christmas gift, especially if you choose one of the projects marked with a dagger (†) in the following list of blueprints.

Our blueprints are each 15 by 22 in. and cost 25 cents a sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. Instructions alone are 25 cents each.

Many other blueprints are available. Send a stamped and addressed envelope for a complete list.

FLYING AIRPLANE MODELS

Bremen (Junkers, 3-ft.), *89-90*.....$ .50
Nieuport XVII, 29-in., *180-181*..... .50
S. E. 5a World War Plane, 30-in., *168-169* .50
Winnie Mae, 4-ft., *141-142-143*..... .75

BOATS

*Canoe, 16-ft. Canvas Covered Kayak, with sail, etc., *192-193-194-R*..... 1.00
*Duck Boat, Folding, *170-R*..... .50
*Outboard Racer, 10½-ft., 114 lb., *211-212-R* .75
*Sailboat-Motorboat, Combination (15 ft., cat rig), *131-132-133-R*..... 1.00
Marconi Rig with Jib for Above, *133A*..... .25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*..... 1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224-R*..... .50

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

FURNITURE

†Bookshelf and Book Ends, Modernistic, *100* .25
Chests, Treasure, *78*..... .25
End Table, Magazine, *68*..... .25
†Lamps, Modernistic, *93*..... .25
Mirror, Scroll Frame, *105*..... .25
†Pier Cabinet and Corner Shelves, *77*..... .25
†Screens, Modernistic Folding, *91*..... .25
Sewing Cabinets, Two, *31*..... .25
†Stand, Low Modernistic, *100*..... .25
†Table, Tavern, *105*..... .25
Table, Tilt-Top, Oak (top 20 by 24 in.) *140* .25

RADIO SETS

All-Wave Portable (battery), *217-R*..... .50
Amateur Short Wave Receiver, *155*..... .25
Amateur Radio Transmitter, *183-184*..... .50
Amplifier, Three-Stage Audio-Frequency, *42* .25
Five-Tube Short Wave (A.C. or D.C.) *223*.. .25
Full Electric Headphone Set, *130*..... .25
†One Tube (battery operated), *103*..... .25
Screen-Grid Set, *109*..... .25
†Short-Wave Converter Unit, *137*..... .25

SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page 71}

†Aircraft Carrier—U.S.S. Saratoga (18-in.) and flush deck destroyer (6¼-in), *226-227-R*..... .75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200* 1.00
Bottle, Clipper Ship in, *121-122*..... .50
Clipper Ship (20½-in. hull), *51-52-53-R*..... 1.00
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†Cruiser *Brooklyn* (8-in.), *236*..... .25
†Cruiser *Tuscaloosa* (11¾-in.), *234*..... .25
Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R* 1.00
Galleon *Revenge* (25-in.), *206-207-208-209*.... 1.00
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R*..... 1.50
Mayflower (17½-in. hull), *83-84-85-R*..... 1.00
†Miniature Coach and Covered Wagon for Decorating Boxes, etc., *202-R*..... .50
Motorboat, 29-in. Cruiser, *63-64-R*..... .75
†Motorboat, Working Model (20-in.), *196*.... .25
†Liner—*Aquitania* (9-in.), *225*..... .25
†Liner—*Manhattan* (12 in. long), *204*..... .25
†Liner—*St Louis* (11-in.), *231*..... .25
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230*..... .75
Santa Maria (18-in. hull), *74-75-76-R*..... 1.00
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†Steamships *Savannah* (3 in. over all) and *Atlantic* (6 in.), *235*..... .25
Viking Ship (20½-in.), *61-62-R*..... .75
Whaler—*Wanderer* (20½-in.), *151 to 154*.... 1.00
†Yacht *Rainbow* (7½-in. hull), *233*..... .25
Yacht *Sea Scout* (42-in. racing), *106-107-R* .75
Yacht (20-in. racing), *48-R*..... .50

MISCELLANEOUS

Doll's House, Colonial, *72*..... .25
†Doll's House Furniture, *73*..... .25
Toy Airplane Cockpit with Controls, *114*.... .25
†Toy Birds and Animals, Jig-Sawed, *56*.... .25
†Toy Drill Press, Lathe, Saw, etc., *113*.... .25
†Toy Dump Truck, Fire Engine, etc., *101*.... .25

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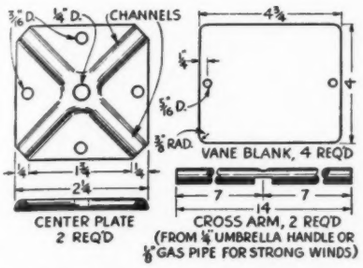
A STURDY Tilt-Top Table

NO HOME has too many small tables. The one illustrated is particularly useful because it takes up so little space when not in use. With the top tilted, it can be pushed close against the wall. The top is 20 by 24 in., and it stands 24 in. high. The best wood to use is oak. If you wish to make this distinctive little table, you can obtain a blueprint and detailed instructions for 25 cents. Order Blueprint No. 140.

MAKING A WIND GAUGE

(Continued from page 65)



A pattern for cutting the four vane blanks, the arms, and the plates that hold them rigid

the four revolutions have been calibrated, lay the trial dial over a suitable piece of cardboard and transfer the points and circle center by pricking through with a needle. Then ink in the circles and divisions on the cardboard, cut out the dial, and mount it on a plywood base, fitting it for installation.

If the anemometer is to be portable, screw the housing directly to the dial, and leave the wire index hand in place. It can then be set in any desired place to test the wind, and can be used to calculate the flow of air in ventilating ducts or between buildings. If the wind is steady, the hand will practically come to rest over the mark showing the velocity; but if gusty, the vanes will oscillate and the average of the swing will be read.

To mount the anemometer on a building, such as the garage, bolt the housing to a suitable block to straddle the ridge boards or to level it on the slope of a shed roof. Bore a 1-in. hole through the roof for the index spindle, and, before mounting the instrument, solder this spindle in the end of the bolt spindle. Thrust it through the hole, smear the underside of the block with roofing tar, nail it securely, and coat the outside with tar. Put a temporary shed or cover over the instrument to shield it from the wind until the dial is set.

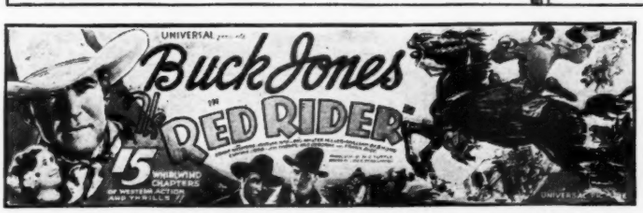
Mount the dial upside down under the roof or ceiling. For this use, of course, it must be calibrated in the opposite direction to one used for a portable instrument. Since the vanes are free to swing through more than one revolution, a telltale is needed to show what circle is to be read. This consists of two clock wheels. A small pinion, drilled to fit the index spindle, is pushed up close to the dial and soldered. The large gear is mounted on the dial in mesh with the other by driving a nail through the center, and a hand is painted on one spoke. Mark the dial "1" to correspond, count around as many teeth as there are teeth on the pinion, and mark "2." Likewise locate "3" and "4."

The hand may be soldered or screwed on.

Table of Squares

V	V²	V	V²	V	V²	V	V²
1—	1	20—	400	39—1521		58—3364	
2—	4	21—	441	40—1600		59—3481	
3—	9	22—	484	41—1681		60—3600	
4—	16	23—	529	42—1764		61—3721	
5—	25	24—	576	43—1849		62—3844	
6—	36	25—	625	44—1936		63—3969	
7—	49	26—	676	45—2025		64—4096	
8—	64	27—	729	46—2116		65—4225	
9—	81	28—	784	47—2209		66—4356	
10—	100	29—	841	48—2304		67—4489	
11—	121	30—	900	49—2401		68—4624	
12—	144	31—	961	50—2500		69—4761	
13—	169	32—	1024	51—2601		70—4900	
14—	196	33—	1089	52—2704		71—5041	
15—	225	34—	1156	53—2809		72—5184	
16—	256	35—	1225	54—2916		73—5329	
17—	289	36—	1296	55—3025		74—5476	
18—	324	37—	1369	56—3136		75—5625	
19—	361	38—	1444	57—3249			

The TREASURE of BULLS EYE BEND
WISE BOYS—YOU TWO—WHEN YOU PICKED THESE NEW BUCK JONES SPECIALS TO TAKE ON THIS TREASURE HUNT. YOU'LL NEED THAT HANDY COMPASS AND SUNDIAL, TOO—THERE'S REAL TREASURE OUT THERE—NOW GO GET IT!!
1 "C'MON, BILL, THIS MAP BUCK GAVE US SAYS TO START AT HANGING ROCK".
2 "IT SAYS TO SIGHT YOUNG JACK PINE DUE EAST."
3 "THERE IT IS, JOHN, I SEE IT!"
4 "THE NOTE SAYS TO STAND ON THE TIP OF THE SHADOW AT 11 O'CLOCK—BY OUR SUNDIALS—AND SHOOT INTO 3 HOLES WE CAN SEE IN THAT STUMP BETWEEN THE TREE AND THE CLIFF".
5 "WHEN I HIT THAT THIRD HOLE IT SOUNDED LIKE THERE WAS A TIN CAN IN IT".
6 "YES, AND THE NOTE IN THE CAN SAYS TO CROSS THE CREEK AND GO UPSTREAM TO THE FIRST SHARP BEND".
7 "HERE WE ARE AT THE BEND. FROM HERE WE GO SOUTH-WEST TO A LARGE, FLAT ROCK."
8 "WE HAVE TO STAND ON THIS ROCK AND BREAK THAT WEIGHTED STRING HANGING FROM THE TREE—AND—SEE WHAT HAPPENS!!"
9 "YOU HIT IT, JOHNNIE, THERE'S A BIG BAG DROPPING FROM THE TREE!"
10 "WHAT IS IT, BILL?"
11 "BOY! IT'S A BAGFULL OF BULLSEYE SHOT! BUCK SURE KNOWS HIS STUFF ABOUT SHOT".



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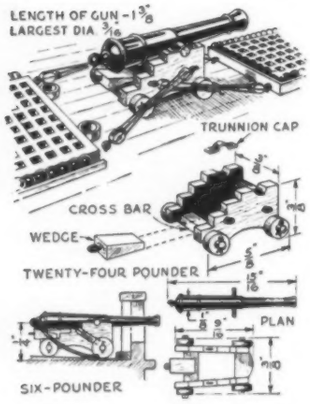
DAISY AIR RIFLES

GUNS AND SPARS FOR OUR PRIVATEER

(Continued from page 69)



Large gun in place, its carriage, and details of the six-pounders

The gaffs and booms are thickest one third from the masts. The ends are slightly flattened to take the jaws, which are glued and riveted through and have holes in the ends for a cord parrel. At the end there is a cleat on either side to keep the sheets in position but still enable them to turn. Outside of these is an eye on either side for the boom topping lifts. For these, bore a horizontal hole, pass the two ends of a bight of thin wire through, pass one end back, twist and cut the ends off. The eyes in the futtock bands and the deadeyes of the bowsprit shrouds can be made the same way.

The jib boom is thickest at the cap, has three holes for the stays, and a stop (step) for the martingale at the end.

The fore-topmast is octagonal as far as the cap, then tapers very slightly to the head, where there is a little stop, thus reducing the thickness, and another similar stop at the topgallant masthead; these, of course, form one spar with the pole. It is bored across near the end for the fid, which is a bar lying across the trestletrees to prevent it from slipping down. It is also bored fore and aft near the topmast and topgallant mastheads for the yard halyards.

The main topmast is similar, except that there is only one stop (that is, no topgallant mast). It is drilled for the fid and gaff topsail halyards. The other spars are for the ringtail (which may be omitted) and are like a stuns'l boom and yard.

The dolphin striker (martingale boom) hooks into an eye under the cap. It has a stop near the end and wire eyes on each side, one third up.

TABLE SHOWING LENGTH AND GREATEST DIAMETER OF SPARS

	Fore	Main
Lowermasts (from deck)	6-5/16 x 3/16	6⅝ x 3/16
Topmasts	6½ x ⅛	6⅜ x ⅛
Bowsprit	4-1/16 x 3/16	
Jib boom	4-3/16 x ⅛ (scant)	
Martingale boom	13/16 x 1/16	
Lower yard	6 x ⅛	
Studding-sail booms (lower)	3 x 1/16	
Topsail yard	3⅜ x 3/32	
Studding-sail booms (topsail)	1¾ x 1/32	
Topgallant yard	2⅜ x 1/16	
Booms	3¾ x ⅛	6½ x 3/16
Gaffs	3⅛ x ⅛	3⅝ x ⅛
Crosstrees	1¾ x 13/16	1¾x13/16
Square mastheads	⅞ x ⅛	1 x ⅛
Total height of masts from deck	12	12
Total length of bowsprit and jib boom	6¾	

KEY TO THE RIGGING

To save space the following abbreviations are used:

F	fore	T	top
hal.	halyards	TG	topgallant
M	main	TM	topmast
P	port	TS	topsail
S	starboard		

The parts are numbered as nearly as possible in the order of application to the model. Those printed in *italic type* should be applied to the last preceding regular number before the latter is installed on the model. The sizes of the cords and blocks are indicated by small letters following the name of the part. Cord *a* is equivalent to No. 20 (B. & S.) gauge wire; *b* to No. 24 wire; *c* to No. 26; *d* to No. 30 (although the *d* size may be used, if preferred, for both *c* and *d*). Blocks *f* are 3/16 in.; *g* 5/32; *h*, ⅛; *j*, 3/32.

1 F mast
2 M mast
3 Cheeks
4 Futtock band
5 Crosstrees
6 Cap
7 Eyebolts and bands
8 Hoops for sail
9 Boom-jaw ring
10 Mast coat
11 Bowsprit
12 Chocks
13 Bees
14 Shroud deadeyes
15 Cap
16 Gammoning
17 F stay a (double)
18 Hanks (wire rings)
19 M jumper stays a c f (P & S)
20 Lower shrouds, deadeyes, and lanyards a c
21 M stay a
22 F boom
23 F sheet c g
24 F boom topping lifts b c g (P & S)
25 F gaff
26 Throat hal b g
27 Peak hal c h
28 Vangs b c h
29 Throat downhaul c
30 M boom
31 Sheet b f
32 Topping lifts b c g (P & S)
33 M gaff
34 Throat hal b g
35 Peak hal c h
36 Vangs b c h
37 Throat downhaul d
38 Peak downhaul d
39 Bowsprit shrouds a c
40 Jib boom
41 Jib-sheet ring
42 Lashing c
43 Martingale boom
44 Boom guys
45 Martingale a
46 Backropes b (P & S)
47 Jib stay b
48 Hanks
49 Jib-stay outhaul d h and sister block
50 F topmast
51 FT shrouds b
52 FT stay b
53 FT backstays a
54 F TG stay c
55 F TG backstays c
56 F yard
57 Jackstays
58 Horses or footropes (wire)
59 Stirrups (wire)
60 Studding-sail boom irons
61 Sling a c and bull's-eyes
62 Truss b
63 Topping lifts b c h
64 FT yard (with parts *57, 58, 59, 60, 62*)
65 Chain tie
66 F TS hal a c g
67 Lifts b
68 TG yard (with parts *57, 58,* 67)
69 TG hal c d
70 M topmast
71 Hoops
72 Shrouds b
73 M TM stay b
74 M TM backstays b
75 F braces b c h
76 F TS brace c h
77 F TG braces d h
78 Lower yard studding-sail boom
79 TS yard studding-sail boom
80 Staysail hal d
81 Staysail downhaul d
82 Jib hal d
83 Jib downhaul d
84 TS sheets b c g
85 TG sheets c h
86 TS clew lines c h
87 TG clew lines d j
88 TS buntlines e j
89 TG buntlines e j
90 F & M sheet ropes b
91 F & M brails e j
92 Gaff TS hal c h
93 Gaff TS sheet c j
94 Gaff TS downhaul e j
95 Gaff TS tack c
96 Staysail sheet c g
97 Jib sheet c g
98 Ringtail sheet

Note: Parts 80 to 98 are sail gear and may be omitted.

The three caps are best made from fiber board, but celluloid or box wood is almost as good. They should be a tight fit and keep the masts and jib boom parallel to the masts below, where they double.

You can finish all spars in a natural color, stain them a reddish brown and varnish them, or paint them white or black, except those sections of the masts where anything hoists. These and the jib boom are "bright."

Next month we shall put on the rigging and complete the model.

***NEVER** throw away short and seemingly worn-out tool bits; they come in handy for use with small diameter boring bars.*

• • •

A good kitchen cleanser dissolved in warm water saves time in cleaning oily machinery prior to painting it.

• • •

An accurate setting of the compound rest for the purpose of boring or turning a duplicate taper can be insured by placing a taper sleeve or arbor between centers and using an indicator in the tool post.

• • •

When calipering a bore in cast iron, be sure that the stationary leg of your calipers is not resting in a spot that is slightly concave.

• • •

In general, the cutting speed for high-speed drills can be figured at two or three times the speed recommended for carbon steel drills.

• • •

If it becomes necessary to make a spring collet, remember that the slots should not be cut all the way out. Leave a light web to protect it from warping in heat treatment and during the internal and external grinding process. It is then a simple matter to use a thin elastic grinding wheel to finish the slots on the nose of the collet.

• • •

Thin tools or gauges should not be marked with an etching machine of the electric type as the heat may warp them. Stencil them before they are ground.

• • •

Any good mechanic who takes a piece of machinery apart can put it together again, but the fact is that he may not be on hand to do it. Always make it a practice, therefore, to stencil all parts when dismantling them.

SUBSTITUTE FOR ROUND BELT MADE OF STRING

IN THE midst of a rush order that called for several days' work on my band saw, the ¼-in. round leather belt broke several times, and I finally made a substitute of white store string. With two renewals, it has given good service for more than a year.

To make such a belt in an emergency, take about ten strands of the string about 1 ft. longer than needed. Hold one end and with the other hand smooth them out. Now tie a single knot about 1 ft. from the end, and continue tying single knots 1 ft. apart the entire length of the belt. Place the belt around the pulleys, bring the two ends together, and tie a double knot, pulling the string as tight as possible. This double knot will ride the small pulley smoothly, and the knots in the belt serve to keep the strands from breaking. With excessive use, the string belt will stretch considerably, and it is necessary to keep it rather tight.—GEORGE L. RAYMOND.

TOURING WINTER SKY WITH OPERA GLASS

(Continued from page 47)

the southern map in January. Algol, or the Demon, goes through its changes in brilliancy in about nine hours. At its brightest it is a second magnitude star (like those in the big dipper's handle). It remains bright for two and one-half days. Then it fades for four and one-half hours and becomes an inconspicuous fourth-magnitude star, which it remains for a few minutes only. Its increase in brightness also takes four and one half hours. The interval between times of minimum brightness is two days, twenty hours and forty-nine minutes, so you can calculate its periods ahead for yourself after observing one of them.

2. PLEIADES: This beautiful little group is high on the eastern sky in December, and equally high on your map. The Pleiades were among the first objects studied by Galileo with his first telescope. He counted thirty-six stars in the group, which was beautifully described by Tennyson in the phrase, "a swarm of fireflies tangled in a silver braid." The Pleiades is a part of the constellation called Taurus, or the Bull.

3. HYADES: This group, also in Taurus, is near the first magnitude star Aldebaran, which forms the Bull's eye. It is somewhat similar to the Pleiades. An opera glass gives you a beautiful picture, and a stronger field glass enables you to see many more faint stars, including several double stars.

4. GREAT NEBULA in ORION: This is only one of the many beauties exhibited by this magnificent star group, which hangs in the southeastern sky during December and January, and crosses to the southwest by March. No other constellation contains so many bright stars. Look for the nebula with your glass about half way down the row of stars which hangs like a sword from the famous belt. Even an opera glass will show you faint stars in the nebula itself, and a field glass makes them much plainer.

5. GREAT CLUSTER in PERSEUS: To see this lovely object we must return to Perseus. The cluster can be seen with the naked eye as a fuzzy star at the top of the constellation. An opera glass brings out some of the many faint stars, a field glass more, and a small telescope makes it a magnificent ball of suns.

6. GREAT NEBULA in ANDROMEDA: This famous object is located high in the western sky for December, when it should be observed, as by January it is on its way to the horizon. It can be seen with the naked eye on a moonless night. With an opera glass it shows as a wisp of light like that indicated in the small circle beside Map No. 6. The stronger the glass or telescope, the more beautiful and interesting the nebula becomes.

7. The VARIABLE STAR MIRA, in CETUS: Look for this star in the group called the whale, about half way to the zenith on your western map. It fades from the second magnitude to about the tenth, when it is invisible to the naked eye for five months. Eleven months are required for this long-period variable to complete its full cycle from maximum to maximum. No wonder the ancients named it Mira, or the wonderful one.

8. STAR CLUSTERS in CANIS MAJOR: Southeast from Orion, the blazing first magnitude star, Sirius, will guide you to a field that richly repays study with an opera or field glass. The cluster marked "41M" in the map is only one of several in the near neighborhood of Sirius.

9. PRAESEPE, or the BEEHIVE in CANCER: The faint constellation called Cancer, or the crab, is rising in the eastern sky during January, and about half way up the sky in February. At its center your opera glass will show you a crowd, or cluster, of lovely little stars, with a brighter one on each side. This cluster is also called the Manger and the two stars the Ass's Colts, feeding from it. Galileo's telescope enabled him to count thirty-six stars in the Manger.

10. The RADIANT of the LEONID METEORS: Late in February you will see the constellation Leo, the lion, rising in the east. While you are sweeping the head or the sickle, note that this is the point from which the Leonid meteors radiate in November.

11. The Famous NOVA in CASSIOPEIA: Look for Cassiopeia high on the northern map. By February it has begun to sink toward the northwest. The Milky Way here is so rich that it repays much study with both opera and field glass. In Cassiopeia, in 1572, appeared a new star, or NOVA. In that year it blazed out and outshone even Sirius, then sank to invisibility in about a year and a half.

12. The COAL SACK in CYGNUS: Here also the Milky Way is glorious in a glass, but is marked by a black spot, called the coal sack. It may be caused by a cloud of dark nebulous matter.

13. DOUBLE STAR in DRACO: Northwest of the polestar, near the horizon in December, look for five stars forming the head of Draco, the dragon. One of these is double and is a good test for the power of an opera glass. Try this star again next summer when it will be better placed for observation.

14. The WATER JAR in AQUARIUS: You will find this striking little triangle above the southwestern horizon in early December. Sweep your glass southward and you will see a lovely stream of little sparklers, which represents the water being poured from the jar.

15. The GARNET STAR in CEPHEUS: This faint constellation is at the left and below the polestar in your Northern map. Map 15 shows the location of the Garnet Star, which is the reddest star visible to the naked eye. In the opera glass it can be found more easily and its color better appreciated. It is a variable with a period of six years.

16. HORSE and RIDER: The star at the bend in the Big Dipper's handle is the horse, Mizar. The rider, Alcor, is immediately above it. The rider was also called the proof by the Arabs, meaning the proof of good eyesight if you can see it.

17. STAR CLUSTER in GEMINI: In the group called Gemini, or the twins, (eastern map) look with your opera glass near its western end for the cluster "35M" at the center of a gorgeous field of small stars. A field glass brings out more details.

FALSE RAINBOW CAUSED BY SUNLIGHT ON CLOUDS

BRIGHT patches of color sometimes seen high up in the sky near the sun are not always rainbows, it is explained by Dr. W. J. Humphreys of the U. S. Weather Bureau. The false rainbow is usually richer than the true arc in greens and reds. It is caused, not by the sun's light striking falling rain, but by its diffraction in the minute particles of moisture contained in filmy clouds. Though occuring rarely, Dr. Humphreys says, the false rainbow may be seen by a watchful observer once or twice a year.

USE FOUND AT LAST FOR RARE METAL, INDIUM

NEARLY seventy years after its discovery, commercial use has been found for the rare silvery-colored metal known as indium. Plated thinly upon electric lamp reflectors, it has been found to reflect lights of various colors with greater fidelity than any metal yet used for this purpose.

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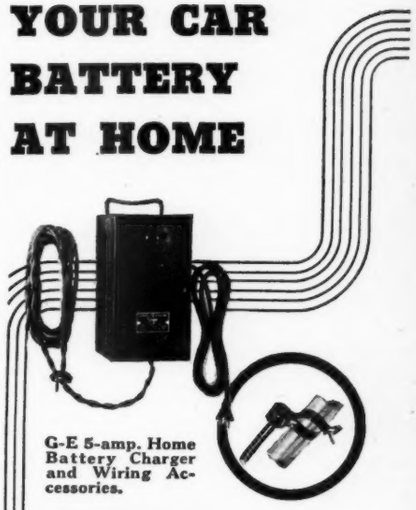

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HERE'S THE ANSWER

(Continued from page 59)

Removing Ink From Wood

H. G., ANN ARBOR, MICH. Ink spots in wood generally can be removed by washing the surface with a strong solution of oxalic acid. Make the solution by dissolving as much crystal oxalic acid in water as it will hold. When the spot has been bleached out be sure to remove all traces of the acid.

Safety Match Striker

N. W., HINSDALE, ILL. An abrasive surface for use in scratching and igniting safety matches can be made easily by mixing red phosphorous (nine parts), pulverized iron pyrites (seven parts), pulverized glass (three parts), gum arabic or glue (one part) and water, spreading it in a thin coating on cardboard, and allowing it to dry.

Pulling Out of a Skid

F. S. K., Jr., LYNCHBURG, VA. To bring a car out of a skid, the front wheels should be turned toward the direction in which the car is skidding. If the motion of the skid is to the right, the wheels should be turned to the right. If it is to the left, the wheels should be turned to the left. In this way the rear wheels will be forced into line with the front wheels.

No More Wash Days

Q.—IS IT true that the government recalls paper money from time to time and washes it?—L. P., Denver, Colo.

A.—AT ONE time the Treasury Department did launder bills to clean them and revive their crispness but this practice was abandoned several years ago because it shortened the life of the paper and faded the printing.

Sun Not So Hot

Q.—IS THE SUN the hottest body in our heavens?—R. B., Salem, Ore.

A.—NO. THERE are blue-hot stars with temperatures as high as six times that of the sun. Astronomers have located over seven hundred of these so-called blue-hot stars.

Change Sex at Will

E. F. D., ST. AUGUSTINE, FLA. Strange as it may seem, oysters have no fixed sex. If she desires, a female oyster after tiring of the duties of motherhood can become a male. Likewise after several months of fatherhood she (or rather "he") can return to the female state.

Money Talks In All Countries

Q.—IS THERE such a thing as a universal language? What tongue is used at meetings of the League of Nations?—I. O. P., Montreal, Quebec, Can.

A.—FRENCH and English are the official languages of the League of Nations. Although a universal language called "Volapuk" was devised some fifty years ago, it never met with world-wide favor. Another so-called universal language, "Esperanto," was devised by Dr. Zamenhof, a Russian, in 1887.

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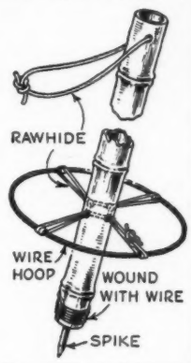
WESTERN COIL & ELEC. CO., Dept. PS, Racine, Wis.

HOW TO CONSTRUCT SKIS

(Continued from page 72)

12 to 15 in. long by the bread-and-butter method and nail the pieces together. The toe should be bent up to a height equal to the width of the ski—in this case 3¾ in.—so lay out the curve on the 4 by 4 in. piece from a point 8½ in. from the end to a point 3¾ in. from the edge. When the block is trimmed to the line, nail it securely to a single larger board. When placing the block, leave enough space beyond the curved end to put another 4 by 4 by 6 in. block.

The second block is built up in the same way as the first, but instead of a curve there is a shoulder cut into one side of it, ¾ by 4 in. The point of the shoulder is placed against the curved block as shown. Hold it in this position while the toe of the ski is placed against the curved block. Now move the smaller block up against the ski as snugly as possible and nail it securely to the board. Tie the two blocks together on top by nailing on another piece of scrap wood. Be sure it is all very strong.



The upper and lower ends of the ski poles

Wrap rags around the toe of the ski to a point a little beyond the place the bend ends. Hold the wrapped end over a large kettle two thirds full of boiling water, and dip the water onto the rags. Four or five minutes of this should soften the wood sufficiently.

Get the ski into the bending form as quickly as possible, but do the actual bending very slowly. With the toe in place, bend a little and then let up on the pressure; then bend again, this time a little more, and release again. Continue in this manner until the whole curve is bent. Then hold the ski in place with a hand screw or large C-clamp (carriage clamp).

Ski Poles. While the bend is setting, you can make two ski poles from a bamboo rug pole. They should be about 4½ ft. long. Plug one end of each pole with a piece of wood. Lash the end with wire to prevent splitting, and insert a 20-penny spike after it has been cut off and pointed. The snow ring, about 6 in. in diameter, is formed from the iron wire with rawhide webbing. Drill two holes about ⅛ in. in diameter through the pole at right angles to each other and about 6 or 8 in. from the spiked end. The webbing is formed as illustrated; that is, the rawhide strips are passed through the holes, and a turn is taken around the ring at four points.

The wrist loop is also made of rawhide and should be large enough to allow free movement of the hand and wrist.

Finishing. When the skis are completely dry, sandpaper thoroughly. Two or three coats of spar varnish on the top and sides are all that is necessary, but the skis may be stained any color desired and the line design filled with a contrasting color before the varnish is applied. No finish other than wax should be put on the bottom or runner sides.

Harness. The harness consists of two straps with buckles for adjustment. One strap passes through the ski and over the toe; the other one is fastened to the toe strap and passes around the heel.

The footplate is a piece of ribbed rubber matting, cemented in place rather than tacked. Place the foot in position on the ski and mark off the spot it covers. The plate should extend an inch or so beyond the actual toe and heel marks.

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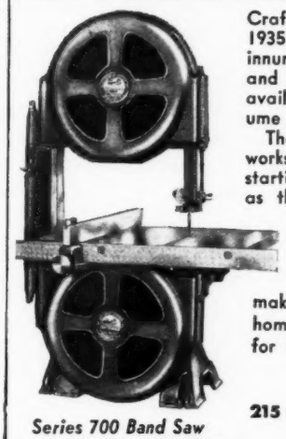

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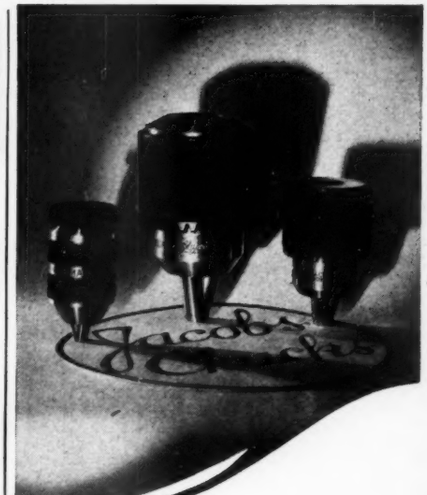

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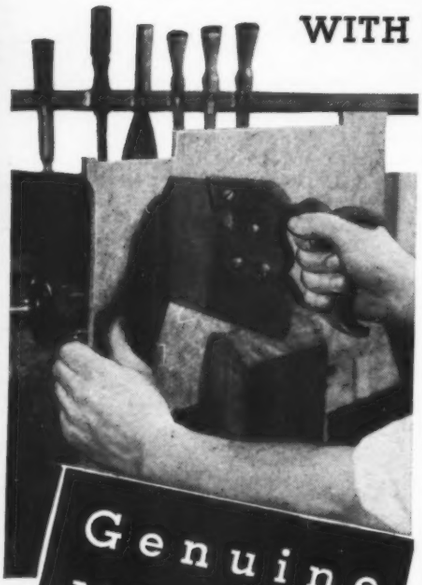

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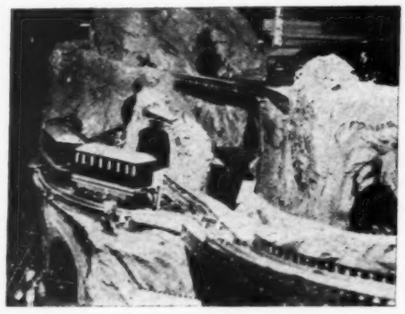


Elaborate demonstration layout made from scrap wood, chicken wire, burlap, and plaster

MODEL RAILWAY SETTING BUILT ON LARGE SCALE

ALTHOUGH so many model makers are eager to construct a suitable scenic setting for their model railway system, they can find little practical help in books or elsewhere. No two settings, of course, will be alike, but I have had long experience in building model scenery and can offer a few pointers that will enable anyone to make a good start in designing a realistic layout for his railroad. Nothing is of greater help in making a model system interesting to operate and watch than a good setting.

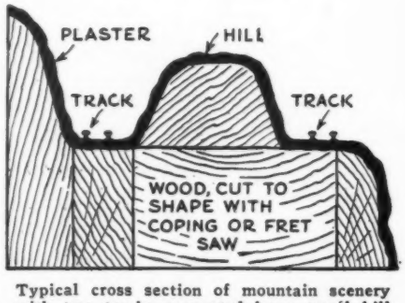
First, make a relief sketch of the scenery that is to be constructed. Then build the required relief out of scrap lumber. Old boxes are the very thing. The general method is as shown in the drawing below. When the underconstruction is complete, small mesh chicken wire is tacked to the woodwork and bent with the hands to form the exact shapes required.

Next take burlap or sackcloth of large mesh and sew it with string to the wire. If a small hillock or knoll is needed, newspaper may be crushed in the hand and shoved under the sacking.

The work is now ready for a plaster of Paris mixture. This is applied in small quantities so that as little waste as possible is caused. Mix about three cups at a time, for this substance hardens very quickly. While applying the plaster, form the sacking and plaster into the shape desired.

When the plaster is dry, give the whole surface a good coating of size or very thin glue and let it dry for twenty-four hours or more. This leaves a hard nonporous surface that will stand a certain amount of wear. A good thing to do is to scrape off all the small, rough edges before applying the size.

The whole surface is now ready for the paint. A coat of green is the best foundation, and when it is dry use a sponge to apply gray and brown for rocks and earth, with a touch of red here and there. A small patch of yellow with spots of red give the appearance of flowers. Trees at a distance are strips of sponge dyed green and touched with brown and red. Trees in the foreground are more difficult to make, but can be prepared with a little ingenuity.—R. S. ROBBINS.



Typical cross section of mountain scenery with two tracks separated by a small hill

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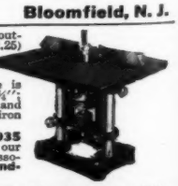

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HOW TO CUT GRADUATED SCALES ON METAL

Graduations cut by hand with a chisel

MOST amateur craftsmen consider the cutting of graduated scales on steel or other metals to be a job that only an expert mechanic should attempt. This task may be performed, however, with only a few simple tools—a combination square, a small, narrow cold chisel ground as shown in the drawing, a light hammer and a vise. Should the work call for numbering, a set of small steel figures may be purchased.

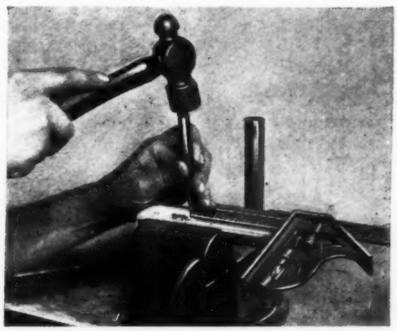
Two samples of finished work are illustrated—a quill for a drill press and the tailstock spindle of a small bench lathe. Both scales were made as shown in the photograph below. The blade of the square is reset for each cut.

The chisel must be ground so that the edge will hug the end of the combination square

Mark each division first with a short, clean indentation; then, with the aid of penciled guide lines, go over the work again free-hand and extend the cuts to the various lengths desired to indicate fractions of an inch.

Go over the cuts lightly with a fine-cut mill file and polish with fine sandpaper wet with oil, rubbing along the length of the piece.

The long index line may be laid out with a marking gage and deepened with the chisel later, or the work may be centered in a lathe and the line scribed with the aid of the slide rest.—R. G. BULLARD.



In marking the graduations, the blade of the square is carefully reset for each division

WRITING ON CELLULOID

WHEN it is necessary to write on articles made of celluloid, or celluloid composition, acetic acid may be used as an ink. The dilute solution (25 percent) sold in drug stores is suitable for this purpose. When dry, the writing will have a dull appearance. The acid may be colored, however, by the addition of a pigment. Dark red may be produced by the addition of a small amount of methyl orange, an indicator, which turns red in the presence of an acid. I use this ink in writing on draftsman's triangles.—EUGENE POHL.

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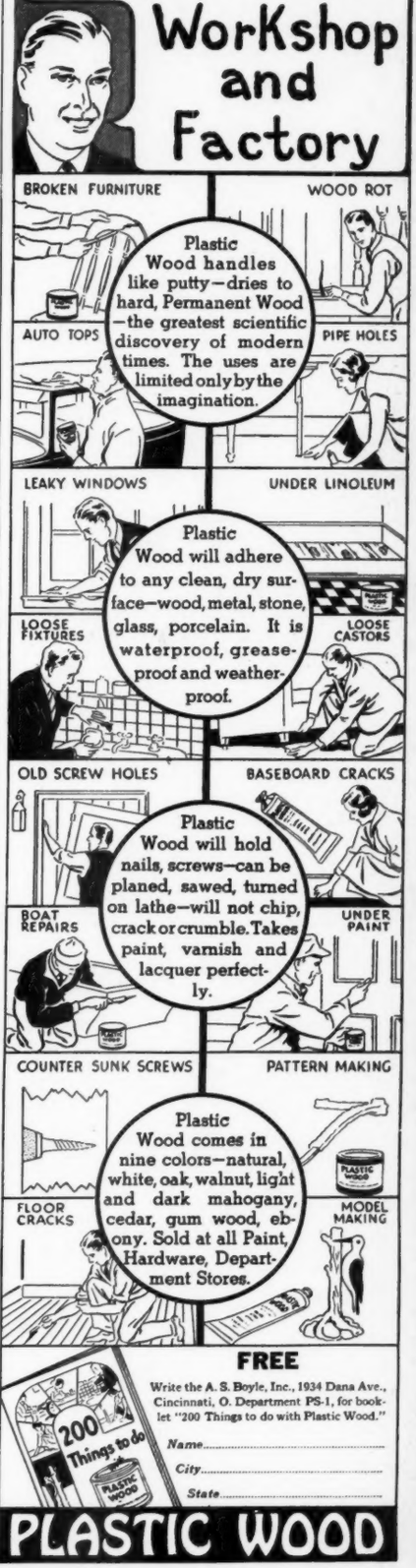
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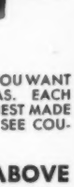

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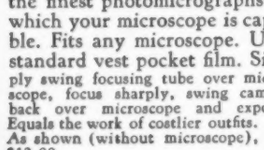

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ANT'S EQUIPMENT SEEN IN YOUR MICROSCOPE

(Continued from page 33)

responding mostly to odor and touch stimuli.

Ants have existed in their present forms for millions of years. One proof that scientists have of this is the specimens embalmed in amber (fossilized rosin) millions of years old. Your microscope will reveal, in a few mo-

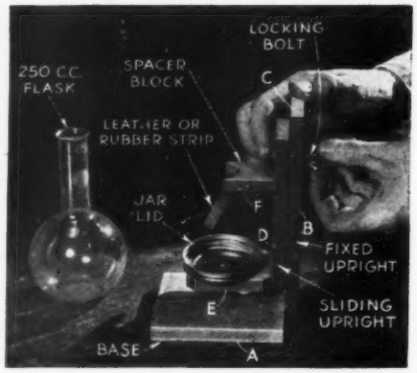


Illustration showing how the wooden holder for the flask of colored water is assembled. A bolt with winged nut makes it possible to adjust the flask at any height or angle required

ments, just why the ant, and insects in general, have been able to survive where apparently more highly developed animals have perished.

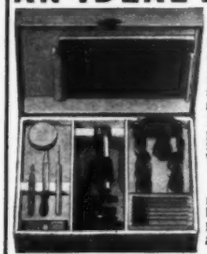
With a sharp scalpel split into two parts the head of an ant. This is easy if you have a dissecting microscope magnifying seven to ten times. Arrange the halves with their flat sides uppermost, on a glass slide, and examine them at moderate magnifications. If the specimen has been prepared properly, you will be able to see how the powerful mandible muscles and other internal organs are attached to the inner surface of the hard shell that forms the ant's head, or "skull." If the specimen had been partly dried in air or by dehydrating in alcohol, slicing the head will not have crushed these delicate structures.

THE ant, therefore, carries its skeleton on the outside, where it will do the most good. In addition to providing the necessary stiffness, the skeleton acts as a suit of armor. No wonder the insects are difficult enemies to subdue when they decide to be unfriendly. Another advantage of the outside-skeleton arrangement is that the attachment of muscles and other organs is simplified. Compared with the ant, you are poorly constructed. The least little bump may damage or destroy one of your delicate organs since it is not protected by armorplate, while a blow of similar magnitude, considering the difference in size, would scarcely be noticed by the ant. Of course, ants in the larval state are not protected by an outer skeleton; but they are guarded by watchful adults who wear natural suits of armor.

From the ant's mouth a gullet leads through the various divisions of the body to the large swollen abdominal section at the rear, where it joins a crop, which is a sac with elastic walls. Next there is a stomach, separated from the crop by a valve; and then the usual intestines and other digestive equipment. Liquids swallowed by the ant enter the crop, and a small portion of the total amount taken in passes through the valve into the stomach. The remainder stays in the crop. The ant is able to force quantities of the crop contents out through its mouth, for the purpose of feeding other ants of the colony.

Thus the ant is equipped with a natural storage bin or tank for food. Observers report that certain *(Continued on page 95)*

AN IDEAL XMAS GIFT



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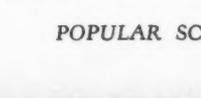

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ANT'S EQUIPMENT SEEN IN YOUR MICROSCOPE

(Continued from page 94)

ants are given the job of obtaining food for the entire colony. These ants sally forth on their errands, fill their crops with liquid food, return to the nest, and distribute it among the other inhabitants by the process of regurgitation. You can watch the crop-filling action by feeding a pale-colored worker some syrup dyed with one of your microscopic stains. When some of the food is given to other workers, their insides become colored too.

TO EXAMINE the crop and other organs with your microscope, remove the bulb-like rear portion of the body, place it in water on a hollow-ground slide, and tear it apart with dissecting needles. You may have to dismember several ants before you get suitable specimens. You will note, among other things, the spiral-walled air tubes with which the ant breathes.

At a magnification of about 400 diameters, you will find many interesting things to study in and on the ant. You will discover, for one thing, that its shiny armor plate is not as smooth-surfaced as it appeared when viewed with lower powers. The surface of one of the abdominal segments, for instance, is seen to be delicately pebbled, like fine leather. Then you will find numerous hairs, or spines, protruding from the surface. Some of these hairs are much larger than the others, and present a peculiarly notched or jointed appearance.

To obtain a specimen of the ant's outside skeleton, suitable for examination at high powers, tear apart an abdominal section as directed, and then separate one of the segments. With dissecting needles, carefully scrape away all unwanted material, press the concave side against a slide, add a drop of water and lay over it a clean cover glass. Tension of the water between the glass surfaces will press the specimen flat.

By all means capture one of the winged ants, for they contain wonders not to be found in the common workers. If you cannot find one of them crawling along the ground on a warm day, dig into an underground nest.

There are, you will find, two pairs of wings, the forward pair being the larger. With sharp-pointed tweezers, remove the wings and mount them in water beneath a cover glass. The wing surfaces, your microscope will reveal, are covered with innumerable tiny spines, or hairs. Examine carefully the front edge of one of the two smaller wings, those that were mounted on the ant's body to the rear of the larger pair. In orderly array along the edge, you will see a series of tiny hooks, curved all in the same direction, like a row of hooks on which the butcher hangs meat in his shop. These hooks look as if they were designed to engage something. Shift the slide until you have the rear edge of the front wing in the microscope field. Carefully move the focusing screw so that you can examine first the upper plane of the specimen and then planes at successively lower levels. You find that the wing edge is curved over to form a groove or channel, into which the hooks on the other wing section fit.

IF YOU have studied the honey bee microscopically, you will remember that it was fitted with a similar hooking arrangement. The purpose of this ingenious mechanism is to enable the insect that possesses it to hook its front and rear wings together so that they present a single surface to the air, and thus provide greater efficiency. When the wings are folded, the hooks automatically slip out of the grooves. This mechanism is one of the outstanding wonders of the insect world.

Remove the rear half of a winged female ant's body and *(Continued on page 96)*

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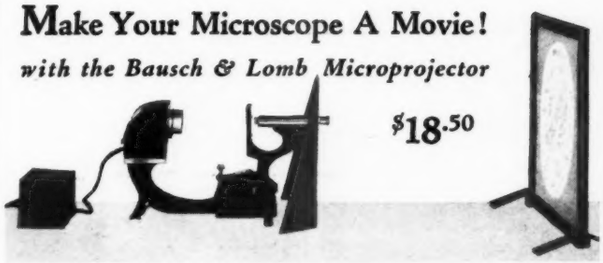

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Illustrating how Microprojector is used in sketching a specimen. Image is reflected to drawing paper on table.

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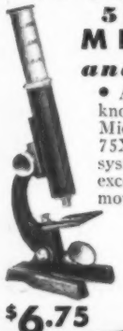

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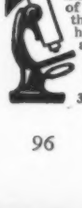

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ANT'S EQUIPMENT SEEN IN YOUR MICROSCOPE

(Continued from page 95)

place it in a drop of water on a hollow-ground slide. With dissecting needles crush the piece and tear it apart. The water will take on a grayish, cloudy appearance. Without placing a cover glass over the water drop, transfer the slide to the microscope stage and examine it at fifty or more diameters. You will see tiny, oily droplets floating about over the surface of the water, the specimen looking for all the world like greasy water you have seen in a kitchen. These droplets of fat may serve as food during the nesting period.

A USEFUL gadget for the microscope table can be made from a glass bottle or flask and a few pieces of wood. The flask is filled with colored water and used as a light filter in front of the microscope mirror. The spherical shape of the flask causes the liquid to act as a condensing lens, concentrating the light into a small area. Laboratory workers who have to spend long hours at a microscope relieve eye strain by filling a flask of the type illustrated with a solution of copper sulphate in water, and placing it in front of an electric lamp. The copper-sulphate solution, being of a blueish color, gives to the light reaching the microscope a daylight quality that is not as tiring on the eyes as unfiltered artificial light.

To make the filtering device, the following materials are required:

Wood parts—

A—One ½-by 4-by-4 in. piece for base.

B, B—Two pieces ⅜ by ⅝ by 7 in. for fixed uprights.

C—One ⅜-by ⅜-by 1½-in. piece for connecting tops of uprights.

D—One ⅜-by 1½-by 5½-in. piece for sliding upright.

E—One ⅜-by 2-by 2¾-in. piece for supporting flask.

F—One ⅜-by 1⅛-by 1½-in. spacer block.

In addition to the wood, the following are required:

One 250-cc round- or flat-bottomed flask, obtainable at laboratory supply houses or drug stores.

One metal jar lid 2½ in. in diameter, to serve as a socket for the flask base.

Strip of soft leather or rubber ¼ x 4 in.

One ⅛-or 3/16-in. stove bolt 1¼ in. long, equipped with wing nut and two washers.

About two dozen nails ½ in. long.

The support for the flask is composed of two parts. One, consisting of the square base and two uprights spaced so that there is a slot between them for receiving the stove bolt, serves as a stand for the movable flask holder. The flask rests in the jar lid which in turn is nailed to the projecting shelf at the bottom end of the sliding upright. The spacer block has its outer end cut to fit the neck of the flask, and is equipped with the rubber band or leather strip to hold the flask in place. Fasten one end of the band firmly with the small nails, and cut a slit near the other end so that it will slip over the projecting head of another nail or brass escutcheon pin. Drill a hole, to receive the stove bolt, about an inch from the top of the sliding upright.

Thus you have, when the parts are assembled, a flexible mounting that permits the flask to be moved up or down and swung forward or back, as light conditions and the position of the microscope mirror require.

In addition to the copper-sulphate solution, there are numerous other colored liquids you can use to control the quality of the light. By keeping on hand several bottles or flasks, filled and corked tightly, you can have a wide selection of inexpensive filters. Various aniline dyes and staining solutions can be pressed into service. Leave sufficient air at the tops of corked bottles to take up expansion caused by heating the liquids in them.

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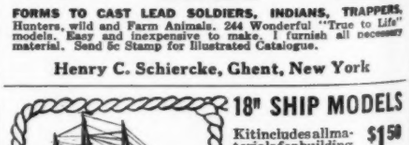

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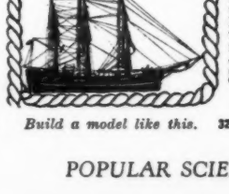

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Build a model like this. **323 S. Douglas Ave., Portsmouth, Va.**

STREAMLINED TRAINS HERALD SPEED ERA

(Continued from page 13)

of the electric locomotive. We have seen the development of such mechanical refinements as compound cylinders, the Walschaert gear, automatic stokers, and boosters. All these transformations, however, have concerned the locomotive alone. Now for the first time we see an entire train redesigned on new principles, operating as a harmonious whole, and attaining unprecedented speeds.

Was streamlining a necessity to make two-mile-a-minute speeds physically possible on rails? That is not the whole truth. The fact is that ordinary steam trains can run at speeds far in excess of those they actually attain in scheduled service, as every railroad man knows. Railroad executives, however, are not interested merely in speed, but in speed plus economy and safety.

WHILE steam trains have made spectacularly fast runs as a stunt, or to meet an emergency, it would be a poor business venture to attempt to run them at such speeds in regular service, even if it could be done without endangering the passengers and crew. Great speed in a steam train is purchased at an excessive price in coal and operating expense, as witnessed by the extra fares charged on fast trains.

Here is where the streamlined train shows its mettle. Wind-tunnel tests, made with exact scale models at the University of Michigan, show, for example, that driving a three-car streamlined train of the Union Pacific design at ninety miles an hour requires only 500 horsepower, while a conventional three-car train would need 1,700 horsepower to propel it at the same speed. The difference represents the power wasted in overcoming air resistance, and becomes still more marked as the speed further increases.

Why not streamline a train, then, and haul it with a steam locomotive? That is exactly what the Baltimore and Ohio proposes to do. A twenty-year-old veteran of the rails, the *Dolly Varden*, is to be rebuilt in the shops, equipped with a water-tube boiler generating 350 pounds of steam pressure, and covered with a streamline jacket. Then it will be used to haul one of the B & O's new streamlined trains, while its performance is checked against that of Diesel-powered trains.

The entrance of the Diesel into high-speed railroading constitutes something of a revolution. Only a short time ago, no Diesel engine could have pulled a first-class train, because a string of heavy steel cars was beyond its strength. Since heavy steel construction was considered essential for safety, huge steam locomotives had to pull the trains. Then aviation, already having presented the railroads with streamlining, made its second gift.

Light-weight aluminum alloys, originally designed for use in airship girders, had been developed that were just as strong as steel and only one third as heavy. Railroad men tried building lightweight cars of the new alloys, and the Diesel engine thus became practical.

HOW these two factors, streamlining and Diesel power, were combined to give economy was demonstrated in the record-breaking run of the *M-10,001* across the country. In this 3,500-mile jaunt, the *M-10,001* burned 2,079 gallons of fuel at a cost of only $83. This represents a fuel cost of two and a half cents a mile, compared with the eight-cent cost of enough coal, fifty-six pounds, to drive a comparable steam train of conventional design the same distance.

Figures like these look good to railroad executives. They know that they have a train that can compete with an airplane, and do it on a paying basis.

STRANGE FACTS ABOUT MUSIC — *by Landron*

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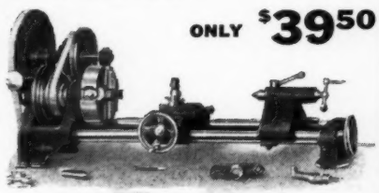

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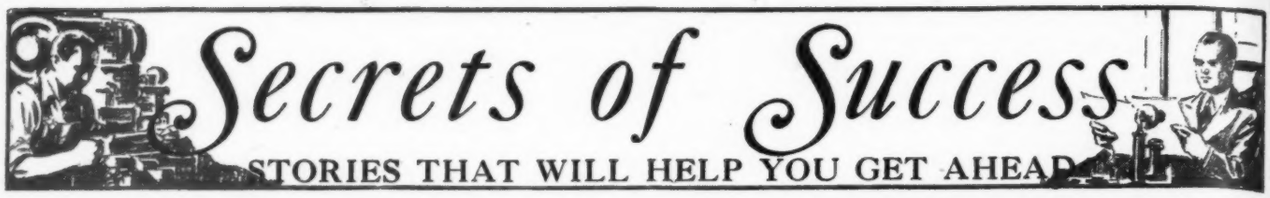

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SILKWORM EXHIBITS PROVE PROFITABLE

WHO would think of silkworms providing a substantial source of income, except on a large, industrial scale? Yet, T. A. Keleher of Washington, D. C., beginning with a tiny silkworm farm in his attic, has built a thriving business and a most profitable one.

This business had its start a number of years ago, when he became interested in silkworms, merely from curiosity to learn the ways of this peculiar insect. Obtaining a few specimens, he experimented with them, studying the various steps in their life cycle. The study proved so fascinating that it soon became a hobby. The more he learned, the more he wished to know.

By the merest chance, this amateur experimenter, while discussing the subject with a school teacher one day, learned that schools were in the market for exhibits featuring the life history and accomplishments of silkworms. Subsequent conversations with other teachers brought out the fact that good exhibits of this kind were quite difficult to obtain and that teachers were compelled to use makeshifts. The only satisfactory exhibits were so high priced that the schools could not afford them.

Accepting this challenge, he canvassed the situation in considerable detail by personal investigation and correspondence. Ultimately, he made several experimental exhibits and submitted them to a number of school teachers for criticism. At last, he was able to produce exhibitional boxes which presented the story of the silkworm from "cradle to grave." Teachers who bought and used them told other teachers about them. He soon found that without spending a penny in advertising his product was becoming quite well known.

The business grew rapidly—he now raises some 20,000 silkworms annually which he subsequently mummifies and mounts on backgrounds or fields of white cotton in glassfaced cases. The group in each exhibit comprises an inflated lifesize silkworm, several handsome white and yellow cocoons, a half-section of a cocoon containing a chrysalis, specimens of male and female moths, a cluster of silkworm eggs, specimens of raw and manufactured silk. The setup is arranged in suitable form for the visual study of juveniles.

In making the exhibits, he kills the silkworms with cyanide and carefully cuts away all parts except the delicate skin. He then inflates the skin and mumifies it with heat, mounting the mummy in simu-

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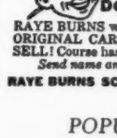

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Secrets of Success

SILKWORM EXHIBITS PROVE PROFITABLE

lation of an adult silkworm. He kills and mounts the moths with the wings outspread, preparatory to placing them in the school cases. The mulberry leaves he obtains from six trees in his back yard. He planted these especially as a source of feed for his silkworms.

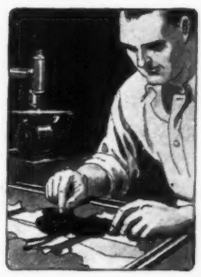
Perhaps a few additional details might be of interest. During the fall and winter he stores the silkworm eggs in a cold storage warehouse, calling for them in May. At that time weather conditions are favorable for the hatching of the eggs. The storage parcel is neither large nor bulky as 35,000 silkworm eggs weigh only one ounce.

The silkworm eggs hatch within 10 days and are kept under mosquito netting, the worms being fed mulberry leaves. It requires 30 days for the worms to mature and attain their full size—about 3 inches in length. Then they begin to shrink. They retire to their brush retreat and discharge silken thread from their spinnarets. Each worm shakes its head at the rate of 65 times a minute—each movement being productive of more silk. During the ensuing 3 days, the insect wags its head 300,000 times, finishes spinning its cocoon and produces about 1,000 yards of silken thread.

In addition to supplying the school-exhibit cases to hundreds of teachers, he also sells silkworm eggs and hatched worms to schools, colleges and scientific laboratories. All this material is used for educational and experimental purposes. Research in silkworms has brought this ingenious man a golden harvest. He always has a waiting list for all the exhibits and research material that he can supply. —G. H. D., Washington, D. C.

• • •

THIS PLUMBER CHANGED HIS VOCATION



IF YOU should chance upon a certain little plumbing shop in Portland, Oregon, you will get the surprise of your life. For on the walls you will see a most remarkable collection, of what I can best describe as "paintings in wood." Actually, they are pictures executed in wood inlay—all of them the work of F. F. Burfitt, the owner. When one looks at these landscapes, portraits and many other subjects, so faithfully and pleasingly executed in wood, it is not difficult to understand why their creator is well on the way to making this work his vocation.

It was not with any idea of selling his panels that this talented plumber became interested in making wood inlays. It was fun—this taking sheets of different kinds

How a "Tip" got Jim a Good Job

BUT JIM, I DON'T SEE HOW WE CAN AFFORD TO MARRY.
MARY'S RIGHT, I REALLY CAN'T SUPPORT A WIFE.
GUESS I HAVEN'T A RIGHT TO ASK A GIRL LIKE MARY TO MARRY AN ORDINARY MECHANIC.
LOOK HERE, N.R.I. HAS TRAINED HUNDREDS OF MEN LIKE ME TO MAKE GOOD MONEY I GUESS I'LL GET THAT FREE BOOK
THIS IS SWELL FUN, AND I AM BEGINNING TO MAKE MONEY ON THE SIDE ALREADY. RADIO SURE IS FULL OF OPPORTUNITIES FOR TRAINED MEN.
YOU CERTAINLY KNOW RADIO. MINE NEVER SOUNDED BETTER
"THANKS" YOU SEE I HAVE TAKEN N.R.I. TRAINING
OH! JIM, IT'S WONDERFUL. NOW YOU'RE ON THE WAY TO SUCCESS
YES MARY, AND THERE'S A REAL FUTURE FOR US IN THIS RADIO FIELD.

I'LL TRAIN YOU AT HOME
In Your Spare Time For A GOOD RADIO JOB

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of veneer and working them into beautiful designs. It was work so different from wiping a joint that it provided pleasant relaxation and there was a creative thrill in it.

But his friends saw something more than a means of amusement in his craft. Here was remarkable talent hidden away in a little plumbing shop among piles of pipes and valves. Many lovers of art would certainly be willing to pay well for these pictures. But Burfitt was not so sure.

However, he did begin to exhibit in a small way—later sending a large panel to Paris where it attracted considerable attention. Then the orders began to come. Some of his pieces sold for as much as two hundred dollars. That money looked good. He realized now that this wood inlay hobby would ultimately become his new vocation.

Within the last few years he has given serious attention to the business angle of his art. His exhibit at the Century of Progress Exhibition has resulted in his receiving inquiries from all over the world. One of those interested in his work is Postmaster General Farley, at whose instance an inlaid wood portrait of President Roosevelt was obtained, to be hung in the post office building in Washington.

Burfitt has the true artistic instinct and, although he has never taken an art lesson, his work has remarkable qualities that will doubtless carry him far. Now, after years of patient work in his hobby, he is finding his wood inlay business so profitable that he will soon be able to put away his plumber's tools and devote his entire time to his new vocation.

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Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

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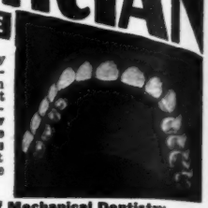

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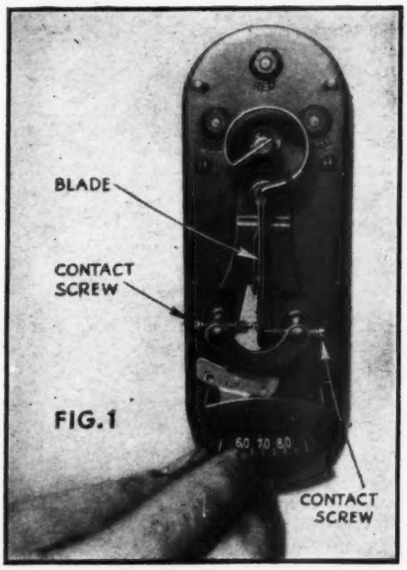
TESTING AND ADJUSTING FURNACE THERMOSTATS



Thermostat with contact screw on each side. The first step is to swing indicator to left

THERMOSTATS for controlling house furnaces or boilers occasionally get out of adjustment with unpleasant results. It is really an easy matter, however, to check them and make any necessary corrections.

First, examine the thermostat to see if it has a contact screw on each side, (Fig. 1), or if both screws are on the same side (Fig. 2).

If it is like Fig. 1, check as follows:

1. Swing the indicator to the left (lower temperature) to stop the burner (Fig. 1).

2. Note the temperature on the thermometer on the thermostat screen.

3. Move the indicator slowly up the scale until a point 1 deg. higher than the temperature shown on the thermometer. At this point the burner should start.

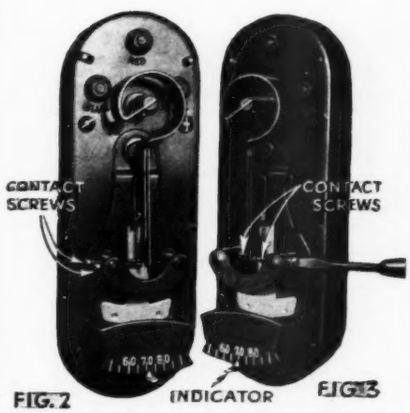
4. Move the indicator to the temperature shown on the thermometer, and the burner should stop. The starting and stopping of the burner is indicated by the sound of the motor in the basement or by noting a tiny spark at the contacts.

If the thermostat proves incorrect, adjust it by taking the following six steps:

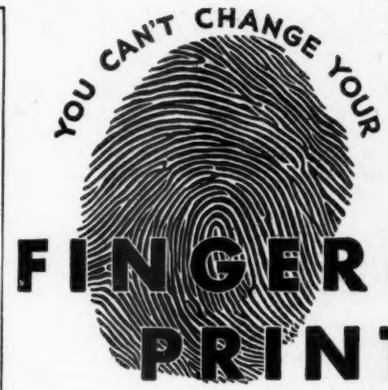
1. Note the temperature on the thermometer, and remove the screen.

2. Move the indicator to the temperature noted.

3. Screw back the contacts (Fig. 1) so that they do not touch the contact blade.



Left: One screw is turned in, the other out. *Right:* The screw is set to touch the blade



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4. Screw the right-hand contact screw *in* very slowly until it touches the blade (Fig. 3). The burner will operate at this point.

5. Move the indicator 1 deg. higher than the temperature noted.

6. Screw the left-hand contact screw *in* until the burner again operates. The adjustment will now be correct.

In case your thermostat has both contacts on the same side, check it as above, but move the indicator to a point 3 deg. instead of 1 deg. above the temperature noted on the thermometer.

If this check reveals faulty adjustment, proceed as follows:

1. Swing the indicator to the left to stop the burner.

2. Note the temperature registered by the thermometer on the thermostat.

3. Remove the screen and hang it at the same level as the thermostat.

4. Screw *in* the outer contact screw one turn (Fig. 2).

5. Screw *out* the inner contact screw one turn.

6. Move the indicator to a point 3 deg. above the temperature noted on the thermometer, and while holding the indicator in place screw the *inner* contact screw *in* until the burner just starts.

7. Carefully move the indicator back to the temperature noted on the thermometer and screw the *outer* contact screw *out* until the the burner just stops.

In each case, the instructions for checking should be followed after the adjustment is made.—RALPH T. MOORE.

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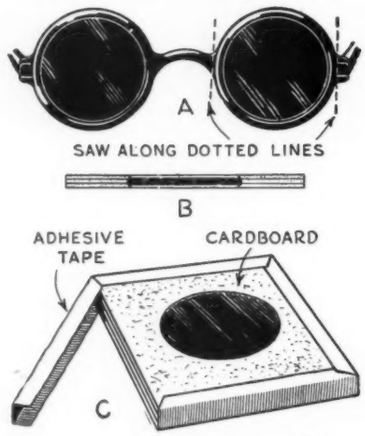

A lens from ten-cent colored goggles is cut out and mounted between squares of cardboard

SQUARES of colored gelatin are usually recommended as filters for amateur microscopic work, but they are easily broken or spoiled by a few drops of water.

To eliminate this trouble, I am using lenses from the various colored goggles sold by the ten-cent stores. The celluloid frames are cut as shown at *A*, and the rough edges smoothed with a file or a piece of sandpaper. Then a 3-in. square of heavy cardboard is cut with a hole exactly the size of the lens used. This forms the centerpiece of the mount. The two outside pieces are made with slightly smaller openings to keep the lens in place. These two pieces can have a slight bevel cut in them, as shown at *B*, in case the lens is thicker than the cardboard used.

A small dab of glue or cement is then placed in the corners and the three sheets are pressed until dry. Finally, a strip of 1-in. adhesive tape is bound around the edges as at *C*. A previous article (P. S. M., May '34, p. 42) described a container that can be utilized for these filters.—IRVING SCHROD.

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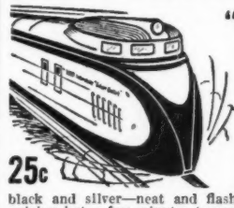

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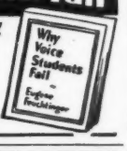

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CAR'S RATTLES FOUND BY TOUCH SYSTEM

(Continued from page 60)

"All right. Now will you step around here for a moment, Doctor," asked Gus as he lifted one side of the hood, "and hold the palm of your hand down there at the bottom of the cowl wall. Notice anything?"

"You can sort of feel the rattle, can't you?" said Dr. Pearson.

"That's right. Now move your hand up toward the top and stop where it seems the strongest," directed Gus. The physician moved his hand cautiously over the partition, first one way and then the other, but always toward the top. "It seems strongest right here," he announced suddenly, his hand resting at the point where the radiator stay rod joined the wall.

GUS reached for the rod and shook it. A sharp metallic rattle could be heard above the drone of the motor. "That's it, all right," he grinned. "And you found it by touch and not by sound. A few turns on the nut that holds the end of that rod will take care of that noise. Now to get down to that clatter you hear every time you hit a bump. That's a plain sign the spring shackles are loose."

"I'd have sworn it was loose body bolts," put in Pearson.

"Never," replied Gus, shaking his head as he walked around to the front of the car. "Two entirely different noises. Loose body bolts generally set up a thumping and drumming sound. Loose shackles, on the other hand, give a sort of metallic clack every time the loose parts slap together."

As Gus talked he reached down and grasped the front bumper in his huge hands. "Listen," he said as he started shaking the car from side to side. Although not as loud, the same clack-clack that was heard when the car bounced over the station road resounded from the general direction of the spring.

"Can that be fixed?" inquired the doctor.

"Oh, sure, we can take care of that all right. We may have to replace a few worn parts but the improvement will be more than worth the little it costs."

"Can't they be tightened?" suggested Dr. Pearson.

"Some shackles can be tightened," agreed Gus, "but not the type used on this car. The only way to get rid of that noise is to put in new pins and bushings."

"Now, there's one other thing I wish you'd set me straight on," Pearson said as Gus started penciling a list of the repairs needed. "How can I get around using oil on the door latches to stop squeaks. It stops the noises all right but my wife gets it on her clothes and then raises Ned."

"TRY a little ordinary hand soap," suggested Gus. "It has plenty of body to it and it won't stain. Just cut a good slice from a large cake of white soap and rub it on the latch.

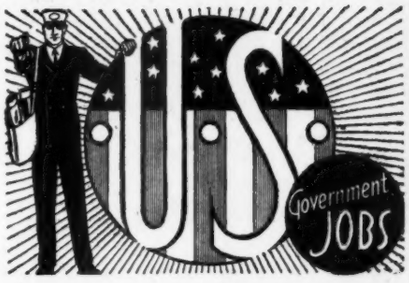
"If the car ever develops any bad body squeaks and you can find the two parts that are rubbing together, soak the joint with a mixture of linseed oil and graphite.

"Speaking of squeaks," put in Dr. Pearson. "I always have a job deciding if some particular squeak is in the motor or in the body. How do you tell one from the other?"

"That's easy. Just drive down the street and when you've got enough speed to roll a few hundred feet, put the gears in neutral and shut off the engine. If you still hear the squeak, it's in the body or the springs. If you don't, it's a cinch it's in the motor."

"How about my car?" asked the doctor. "Will it take you long to put it in shape?"

"Come back in about three hours," replied Gus, "and it'll be as silent as it ever was."



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THINGS TO MAKE IN THE HOME LABORATORY

(Continued from page 55)

applied with a cloth and rubbed briskly.

If the paste-type polish is made sufficiently fluid by using enough ortho-dichlorbenzine, the home experimenter can store it in convenient collapsible tin tubes in the true commercial manner. Unfilled collapsible tubes can be purchased at almost any drug store. Simply pour in the paste and fold and pinch over the ends.

ANY one of a number of simple formulas can be used by the home chemist in manufacturing his own transparent cement. Although a fairly good product can be obtained simply by dissolving scraps of celluloid in acetone or amyl acetate, a far better adhesive can be made by using cellulose acetate in place of the celluloid. The product then will be non-inflammable but because of the solvent used will have a tendency to blush or whiten as it evaporates. To prevent this, an additional solvent, ethyl lactate, can be added. Being what is known as a "high boiler," it will raise the boiling point of the mixture and retard the evaporation of the solvent.

Taking all of these suggestions into consideration, the home chemist will find that one of the best cements will consist of the following: acetone (ninety cubic centimeters), ethyl lactate (ten cubic centimeters), and cellulose acetate (ten grams). If the resulting cement is too thin, it can be thickened by adding more cellulose acetate. Incidentally, it will take the cellulose acetate at least two days to dissolve in the solvent so do not be in a hurry to put your finished cement to work.

Another cement employing a plastizer to improve its bending and flexing qualities can be made by mixing cellulose acetate with about twenty-five percent of its weight of ethyl phthalate and dissolving it in a liquid made by mixing acetone (fifty parts), ethyl lactate (twenty parts), ethyl acetate (fifteen parts), and toluene (fifteen parts). The resulting cement can be used on any material except rubber and may be packaged in collapsible tubes if some precaution is taken to keep them air-tight.

Perhaps you have at some time wondered about the transparent, jellylike caps often used to cover the stoppers on medicine bottles, iodine vials, and pill jars. These too can be made in the home laboratory. In fact, the home chemist can put them to good use in keeping his stored chemicals fresh and free from moisture.

THE inexpensive mixture used in making the jellylike coating consists of unflavored and unsweetened cooking gelatine (eleven grams), water (seven cubic centimeters), and ten drops of glycerin. Heat the mixture slowly over a water bath, stirring it continually. When a liquid results, dip the stoppered ends of several bottles into the solution and allow them to dry. After several hours, their necks and corks will be encased in the same celluloidlike caps that you have always associated with a drug store. If colored caps are desired, the mixture can be colored with any ordinary household dye.

SALT PROTECTS MINERS FROM HOOKWORM DANGER

COMMON salt is being used in the deep gold mines of the Rand district of South Africa to protect workers from the parasitic disease of hookworm. By coating corridors, buckets, cages and all exposed earth and waste with a salt solution, the eggs are prevented from hatching and larvae are killed.

POWERFUL GAS WEAPONS AID WAR ON GANGSTERS

(Continued from page 26)

serve as signals in more extensive operations.

Next in size to the field gun is a one-inch riot pistol that looks somewhat like a harmless water pistol, except that it is larger. This pistol is similar to the old Very signal pistols used in the World War; in fact, converted Very pistols have been used for gas work. A single shell will make 25,000 cubic feet of space instantly uninhabitable, the effective range being twenty-five feet.

THE up-to-date policeman's or watchman's billy is capable of more than denting heads. It is in reality a tear-gas gun, effective anywhere up to twenty or twenty-five feet, depending on size. It is hollow for part of its length, and carries a tear-gas shell which can be fired by releasing a trigger. Normally the trigger cannot operate because of the action of a safety device.

Tear-gas fountain pens, which have been widely distributed to motorists and others desiring protection against holdups, have developed an unfavorable reputation because they look too much like the ordinary type of fountain pen. Accidental discharge by persons not familiar with their true nature is likely to cause discomfort if not more serious injury. So manufacturers are discontinuing the tear-gas pistol that looks like a pen, and which was not considered by gas experts as being big enough to provide really effective protection.

One manufacturer has introduced, as a substitute for the pen gun using a .38 or .410 calibre cartridge, a gas projector using a 20 gauge shotgun shell filled with tear gas. This instrument is almost large enough to serve as a black-jack after it has been fired; but it is a more effective weapon if grasped so that either end can be used like a battering ram. Small enough to be carried in the coat pocket, yet using a shell twelve times as effective as the .38 calibre type, this gun has been designed for the use of watchmen, bankers, business men, doctors, gasoline station operators, jewelers, automobile drivers, and even housewives.

Tests with various types of tear-gas dispensers have yielded the following figures, according to A. S. Ailes, of the Lake Erie Chemical Co., Cleveland, Ohio, a pioneer developer of peace-time gas and equipment:

Type of dispenser	Unit of comparison	Range	Spread
.38 calibre pen	1	6 ft.	2 ft.
.410 calibre pen	3	12 ft.	3 ft.
20 gauge projector	12	15 ft.	4 ft.
12 gauge club	21	20 ft.	5 ft.
1-in. riot pistol	78	30 ft.	9 ft.
Short range field gun shell	156	35 ft.	15 ft.
Long range field gun shell	222	450 ft.	30 ft.

Thus the one-inch riot pistol discharges seventy-eight times as much gas as a .38 calibre pen and carries five times as far. Ranges apply to still air only.

A person not expert at throwing grenades can hurl a typical non-explosive tear-gas grenade about fifty feet. Such a grenade produces about as much gas as the one-inch riot pistol, but takes a minute to do it. Explosive-type grenades discharge double that quantity, and cover a circle thirty feet in diameter. Fast tear-gas candles produce four times as much gas, over an immediate circle of sixteen feet, which rapidly enlarges because of air currents.

TEAR-GAS pistols and the like are supposed to be aimed at the chest of the target, when the nature of the situation demands this courtesy. However, accidental discharge may cause the gas and wadding to be driven squarely into the face. In such cases, injury may be caused by solid particles of wadding.

The victim of tear gas will find quickest relief by getting *(Continued on page 105)*

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POWERFUL GAS WEAPONS AID WAR ON GANGSTERS

(Continued from page 104)

into the open air and turning his face towards the wind. An electric fan may help. Rubbing the eyes only increases irritation. Washing the eyes with saturated boric acid solution or a two percent solution of ordinary baking soda is helpful. Swelling of eyelids may be treated with Epsom salt compresses. For skin irritations resulting from high concentrations of gas, bathing with baking-soda solution, followed by carron oil, has been recommended. Severe gas irritation is much like a burn from hot water, and can be treated in a similar way.

When the victim has got too close to some irritant smoke (KO or DM gas) washing the nose and throat with boric acid solution or a solution made by adding a teaspoonful of table salt to a pint of water, will help. Absolute rest is desirable.

Banks and postoffices are finding, in tear gas and its allies, the answer to some of their most perplexing problems. Safe designers and gas experts have cooperated in developing protective systems which discharge overwhelming clouds of gas and relock the safe, as soon as some one begins to tamper with it. Heat of torches acts on one of several thermostats built into the door, releasing the gas. Tampering with the lock with electric drills or any other tool likewise will set the protective system to work. Burglars have been foiled in no less than 156 banks and fourteen United States post offices protected by such gas equipment. The gas installation does not interfere with normal opening and closing of the safe door in any way.

NEW PHONE SWITCHBOARD TAKES BLIND OPERATOR

EMPLOYING tiny triggers which rise from the surface of the mechanism instead of lights, a new telephone switchboard that can be operated by blind persons has been invented by a blind Illinois youth. With the assistance of numbers in Braille beside each trigger, a blind operator is able to make connections as promptly as a person possessing vision. The new invention is smaller than a tabloid newspaper and three inches thick. It can be attached to any standard switchboard having a capacity up to 320 lines. The Illinois Telephone Co. has undertaken the manufacture and installation of the board which is expected to furnish employment for many blind persons.

ELECTRIC EYE MEASURES AREA OF LEAF SURFACE

A PHOTO-ELECTRIC cell measures the area of irregularly-shaped leaves in the plant research laboratory at Purdue University, Indiana. The light-sensitive bulb is located within a box covered by a ground-glass plate. Outside this plate, a ring of a dozen 100-watt electric lamps sends a steady light into the box. When the leaf is placed on the glass, it cuts off light exactly in proportion to its area. By comparing the reading on a meter attached to the cell before and after the leaf has been placed in position, an accurate estimate of its area is obtained.

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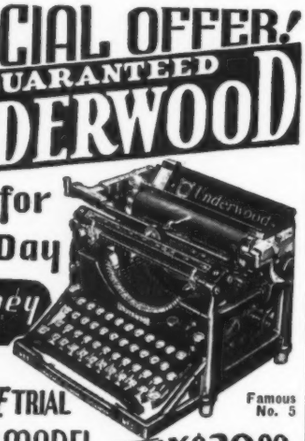

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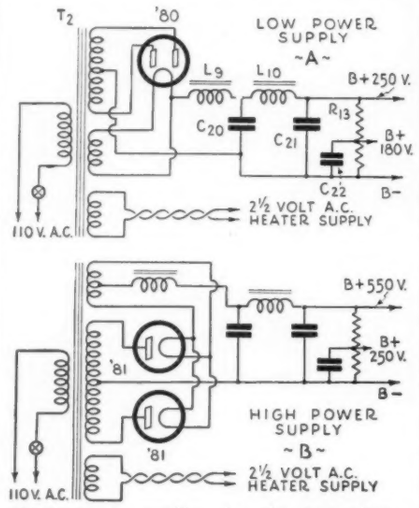
PHONE TRANSMITTER FOR THE AMATEUR

(Continued from page 57)

tenna coupling unit should be connected next and the twenty-five-watt light bulb wired temporarily in series with the antenna. With this arrangement, condensers C_{16} and C_{17} should be adjusted for maximum bulb brilliance.

As a final adjustment, the radio-frequency and audio-frequency inputs should be set for proper operation. This can be best be done experimentally by listening in on a monitor or an ordinary one- or two-tube short-wave receiver operated without an antenna. The audio-frequency volume control (R_9) should be advanced to its maximum value and R_4 decreased until the speech is intelligible. The control R_9 then should be decreased until there is no evidence of garbling caused by over modulation.



Two power supplies for the transmitter

The following is a list of the parts needed:

X.—"Y" crystal and holder, 1800-2000 kc.

L_1, L_3, L_6, and L_8.—Coils, see text.

L_2, L_4, and L_7.—R. F. chokes, 8 mh.

L_5.—Audio-frequency transformer, 3 to 1 ratio, primary and secondary wired in series.

C_1.—Variable condenser, 150 mmf.

C_2C_4, C_5C_7, and $C_{12}C_{15}$.—Dual by-pass condensers, .05-.025 mfd.

C_3, C_9, C_{18}, and C_{19}.—Fixed condensers, mica, .0005 mfd.

C_6.—Fixed condenser, mica, .004 mfd.

C_8.—Adjustable mica condenser, 10-70 mmf.

C_{10}.—Fixed condenser, paper, .01 mfd.

C_{11}.—By-pass condenser, tubular, .5 mfd.

C_{12}.—Dry electrolytic by-pass condenser, 25 mfd. 50 volt.

C_{14}.—Variable condenser, 105 mmf.

C_{16} and C_{17}.—Variable condensers, 500 mmf.

R_1 and R_5.—Fixed resistors, 100,000 ohms.

R_2, R_8, and R_{11}.—Resistors, 10,000 ohms.

R_3.—Fixed resistor, 500 ohms.

R_4.—Potentiometer, 50,000 ohms.

R_6 and R_7.—Fixed resistors, 20,000 ohms.

R_9.—Potentiometer, 500,000 ohms.

R_{10}.—Fixed resistor, wire, 2000 ohms.

R_{12}.—Fixed resistor, 5000 ohms.

T_1.—Microphone transformer.

M.—Milliammeter, 0-50 ma.

Miscellaneous: Two chassis, tubes, shields, microphone and battery, sockets, etc.

POWER SUPPLY PARTS

L_9 and L_{10}.—Filter chokes, 15 h., 100 mil.

C_{20}, C_{21}, and C_{22}.—Dry electrolytic filter condensers, 8-8-8 mfd., 450 volts D. C.

R_{13}.—Voltage divider, 10,000 ohm, 50 watt.

T_2.—Power transformer, 700-volt center tapped at 100 mils., 5 volt at 2 amps., and 2½ volts at 8 amps.

Miscellaneous.—Tube, socket, chassis, etc.

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HAULING STUNTS BY BIG MOTOR TRUCKS

(Continued from page 15)

Coney Island. In his predicament, the owner appealed to the Gerosa company. Again, its equipment saved the day.

Two trucks and trailers, facing in opposite directions, supported the two ends of the big car. For more than three miles through narrow and often crooked streets, the two machines moved slowly along, one pulling and the other, with dead engine, rolling backward, its driver steering around curves like a fireman at the rear of a hook and ladder outfit.

THE car was loaded on the trailers during the day and the strange journey began at midnight. By dawn, the whale was at Coney Island ready, according to the owner, to "amaze, amuse, and educate" the visitors.

In the early days, the company used to get in touch with the police and go over routes with them before every job of heavy hauling. This is no longer necessary. The big trucks and trailers have traveled so many thousands of miles through the streets without serious accident or damage that the police give them practically free run of the thoroughfares. Whenever possible, heavy traffic is avoided. But sometimes rush jobs send them working their way through congested sections in the middle of the day.

Forty-five-ton electric generators, forty-ton turbine shafts, huge dryers for fireproofing lumber, and a twenty-eight-foot steel torpedo traveled in this way through rush-hour traffic. The tropedo was built by a New York inventor to be controlled in the water by radio waves. Navy officials witnessed trials off Sandy Hook and the Gerosa truck transported the heavy pointed cylinder from the laboratory in the Bronx to the testing place. A special cradle on the truck enabled the men to slide the torpedo into the water at the end of the trip.

Steam shovels and cranes are common loads. The biggest job of the kind was a 110-foot steel boom run by a crawler-type tractor. It was used to lift a war-memorial statue to the top of a fifty-foot marble column. The statue came by truck from Providence, R. I., to New York and the boom, close to half a block long, rode seven miles through city streets to reach the site of the column.

A couple of years ago, when the Bronx County Courthouse was going up, seventy-ton pieces of pink Georgia marble, each eight feet wide, eight feet high and twelve feet long, went to the site by truck. Houses were built over the blocks and sculptors worked inside for months. Another huge block of marble, eleven feet wide and seventeen feet long, traveled on a Gerosa trailer from New York to Washington, D. C., where it was carved into a statue commemorating the Titanic disaster. Frequently, from thirty to forty horses would be required to pull blocks of marble and limestone which now roll along at eighteen miles an hour on the company's trailers.

STEEL jobs run to far greater weights. Forty- and fifty-ton pieces are common and hundred-ton trusses are frequent. From seventy-five to eighty percent can be cut from the costs by fabricating steel at the mills instead of having it riveted together at the place where the building is going up. So larger and larger pieces are shipped from the mills. Only heavy haulage equipment such as the Gerosa company has developed, makes this possible.

When the New York Central Railroad elevated its tracks in one section of New York, not long ago, 100-foot steel sections were brought by truck and lifted into place by cranes as though they were planks. Again, during construction *(Continued on page 108)*

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HAULING STUNTS BY BIG MOTOR TRUCKS

(Continued from page 107)

of the West Side Express Highway along the lower Hudson, sections ninety-seven feet long and all ready even to the railing along the side, were fed by truck to the iron workers at the rate of half a dozen a day.

THE heaviest single pieces of steel ever carried by the trailers weighed 150 tons each. They were sections used in a New Jersey bridge. When carrying unusually heavy loads, the company frequently goes ahead and adds special bracing to the bridges over which the trucks have to pass. Only four times in the history of the company have bridges buckled under heavy loads. In each case, the organization repaired the damage in short order.

It was eighteen years ago that the unique concern was started by Lawrence Gerosa, the head of the company. With a second-hand light truck, he began delivering packages. Later, he bought a heavier machine and hauled bathtubs, radiators, and boilers. While doing this work, he devised new equipment for getting heavy objects into cramped quarters. This rigging enabled him to tackle heavy haulage jobs that stumped other truckers and to get into the field in which his concern has become famous.

At the present time, the Gerosa fleet contains trailers that will hold as much as a freight car and yet will make as sharp a turn as an ordinary truck. Double turntables, tractors with fifth wheels, gooseneck trailers, dollies, and trunnion wheels are responsible for the feats of the machines. On some of the eight-wheeled trailers, the weight is so evenly distributed that a huge load can pass over the cover of a manhole without cracking it. Special equipment is worked out, plans are drawn, and then the factories which produce trucks and trailers turn out the desired apparatus according to specifications.

More than once, Gerosa equipment has rolled along near the head of a famous parade. Three years ago, when Wiley Post and Harold Gatty coasted to a landing at Roosevelt Field after circling the globe in record time, a problem arose. The red and white Lockheed monoplane, the *Winnie Mae*, which had carried them safely on their flight was too wide-winged to tow across any bridge into Manhattan for the parade of welcome. Finally, it was brought up the East River on a barge, unloaded at Fifty-Seventh Street and towed down Fifth Avenue on one of the Gooseneck trailers of the Gerosa company.

Another record breaker that made an overland trip on the same sort of carrier was Gar Wood's speedboat, *Miss America X*. At the end of an exhibition at Atlantic City, N. J., it traveled by truck to Boston, Mass., for a motorboat show. As the racing craft held eight tons of engines, there was constant danger that a jar would crack the delicate hull in half. Yet, at the end of the long trip, the trailer delivered the boat in perfect condition.

TWO years ago, a ship steamed into New York Harbor with the largest hand-tufted rug in the world. Designed for the main lobby of the new Waldorf-Astoria Hotel, it was seventy feet long and almost fifty feet wide. Thirty skilled workers had spent ten months tying the 12,600,000 knots it contained. Together with a smaller rug, it weighed five and a half tons as its box was hoisted from the hold of the ship and placed on a Gerosa trailer.

A power crane was waiting on Park Avenue when the truck drove up in front of the hotel. It swung the huge box to the sidewalk. The rug was placed on a dozen piano dollies and in a few minutes was safely in the lobby of the building. Last summer the truck and trailer drove up again to take the giant rug out for a cleaning.

Probably the most curious of all the jobs undertaken by Gerosa men was the rescuing of thirty-six stranded trolley cars. In repaving streets in White Plains, a dozen miles from New York, part of the rails of a street-car line which had just lost its franchise were torn up. The cars were like fish left in a low-water pool. The company that owned them wanted to run them to New York but it couldn't get them past the break in the track. So it sent an SOS to the Gerosa concern.

IN A few hours, trucks with special trailers carrying short sections of track appeared in White Plains. The twenty-two-ton street cars were run up on the trailers under their own power, hauled to Harrison, another town six miles away, and run off on tracks that connected with Manhattan. Then motormen ran the cars over these rails to the city where they were put in service. The trucks rode six cars a day and at the end of less than a week had rescued the entire fleet.

Lunch wagons, diners and houses by the score have been carried on the trailers. One winter, a building fifty-one feet long, twenty-seven feet wide and seventeen feet high, was moved three times. It was the headquarters of engineers supervising a subway job. As it contained all the blueprints and other materials needed in the work, it had to be shifted from place to place to keep up with the advancing tunnel. Each time, it was lifted on and off the trailer without even disconnecting the steam heating plant it contained.

Before the completion of the George Washington Bridge, all high loads had to cross the Hudson River between Manhattan and New Jersey by ferry. As the machines could not drive under the ferry's low upper deck, the boat had to turn around and back into the slip when it reached the opposite shore. Each trip cost sixty dollars. Three dollars is the present big-load toll on the new bridge.

When engineers were planning this huge span, they consulted the Gerosa company. They discussed developments likely for the future and looked over pictures of the strange, giant loads the trucks are called upon to carry. They wanted to build a bridge to meet the heavy haulage requirements of a decade hence. And they knew that if bigger, heavier, more unwieldly loads are hauled, Gerosa trucks will haul them.

NEW BOILING POOL IS BORN AT YELLOWSTONE

TONS of rock were dislodged and some hurled thirty feet away, when a new pool of boiling water recently made its appearance in Midway Geyser Basin at Yellowstone Park. At intervals, violent boiling takes place in the muddy water and a slight shock is felt in the ground extending several feet back of the edge. No one witnessed the birth of the new pool which was discovered by one of the rangers while making his rounds.

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WHEN a twin-motored air liner took off from Newark Airport, N. J., recently, twelve of its passengers rode in cages,—a dozen prize canaries traveling by air from New York to Atlanta, Ga. It is said to have been the first shipment of canaries by air in the United States. Traveling time was cut to one third.

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WILD TURKEY PARADISE SAVES OUR FAMOUS BIRD

(Continued from page 23)

feed as was to be found on the preserve. Bridges had counted on this, and the club grounds, as a result of his foresight, abounded in the wild fruit, berries, and grain that tickle a wild turkey's craw. Most of the turkeys returned. Each new generation of the wild turkeys has its fling at liberty but eventually finds its way back.

The vast preserve was divided by strips of woodland into thirty hunting fields and the edges of each strip sown each year with corn, wheat, barley, rye and millet. This grain provides an unfailing source of provender, not only for the turkeys but for the pheasants, quail, and other game birds bred on the preserve.

ALTHOUGH thus protected against hunger, the turkeys were still menaced by natural enemies. Hawks, minks, skunk, horned owls, foxes, opposums, and raccoons discovered the preserve was an inviting hunting ground. Some of these pests destroyed the turkeys; others, such as crows, robbed the nests of the birds that had been given their freedom. Against the nest robbers, the turkeys could do little but their defense against birds of prey was amusing and effective. The horned owl, one of the most persistent pests, sometimes discovered the turkeys to be more than a match for him. Singling out a particular bird, he would make a lightning swoop. The keen ears of the turkeys would warn them of his approach and when the owl arrived he would find his intended victim crouched forward, with its head lowered and its tail feathers fanned out like a tilted shield. The owl would hit that shield and slide off like hail from a tin roof. The turkey would then drop to the ground and scurry off to safety.

The sub-surface fences were, of course, powerless to prevent the entrance of predatory birds and could not entirely bar the destructive rodents. The only sure remedy was traps. So each fall, after the windup of the hunting season, a crew of experienced trappers was outfitted with 40 steel traps and set to work cleaning up the pests.

There still remained the serious problem of disease. In captivity, the wild turkeys fell prey to many of the diseases that plague domestic fowls, particularly diarrhoea and blackhead. Bridges found he could control the latter, a liver and intestinal malady, by giving the turkeys potassium permanganate in their drinking water and, in the case of birds two to eight weeks old, by giving them about two ounces of sour milk a week. A strict watch on the condition of the pens and houses and on the diet of the birds helped combat the diarrhoea.

BREEDING naturally consumes most of Bridge's attention, since upon this vital step depends the well-being and growth of the flock. When the first birds were released, Bridges reserved a group selected for their hardihood and quality. The descendants of these breeders, with wings clipped, are kept in a number of fenced and wired ranges, each extending over one and one-half acres and covered with an excellent stand of grass. The fence is wood up to four feet and wire above. The wood is used to keep the birds from injuring themselves by dashing against the wire in an attempt to escape when they are startled. These ranges now hold about thirty gobblers and 200 hens. The best gobblers are valued at $100 each, the hens at about $50.

During April, the brood hens are confined to the laying houses. Each hen lays about two dozen brown-speckled eggs about half again as big as a chicken egg. From the total production, about 3000 eggs are selected for incubation. The *(Continued on page 110)*

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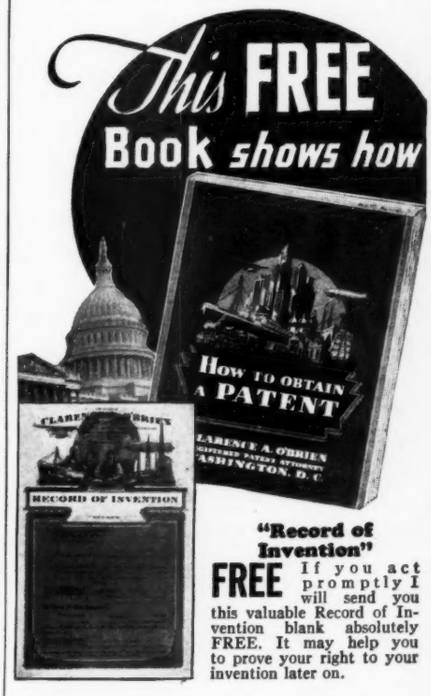

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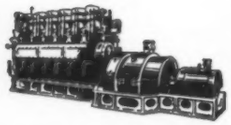

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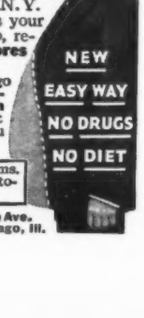

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WILD TURKEY PARADISE SAVES OUR FAMOUS BIRD

(Continued from page 109)

electric incubator that is used takes the entire batch at once and, as a rule, hatches out practically all of them.

For the first six or eight weeks of the young turkey's lives, the period during which they are particularly susceptible to disease caused by dampness, they are kept in heated brooder houses. During this term in the natural state, wild turkey hens have a system of their own to protect their young. John James Audubon, the famous ornithologist, reported that during the wet weather the hens feed the little ones buds of the spicebush, as a human mother might give a child lemonade to counteract the effects of a cold.

WHILE in the brooder house, the young turkeys grow a good coat of feathers and learn to eat mash and grain. They are then removed to the roosting houses next to a carefully tended range. By the time they are three months old they are ready to forage for themselves and leave the roosting houses.

The young birds at this time reveal the wild strain that is in them by scurrying immediately for cover. Were it not for the fine mesh wire enclosing the ranges reserved for them, it is doubtful if the young birds could be kept from going completely native. As the turkeys age, they become nearly as tractable as barn-yard fowl. In the presence of Bridges and of the game-keeper, they exhibit no fear whatever and make no effort to leave the preserve.

The maturing birds destined for distant preserves and breeding farms are shipped by express in special slatted crates, lined with burlap to protect the birds from injury. Since even grown turkeys are likely to contract disease from too prolonged contact with water, moisture is supplied them by means of apples which are halved and placed in the crate. For food en route, the bird is given unshelled corn. Thus provisioned, it can make a four- or five-day trip.

Usually about 2,000 to 2,500 turkeys are thus distributed each year. Excess birds are liberated to join the other domestically raised but now wild turkeys on the preserve. It is these birds that each fall furnish such ideal sport for the millionaire members and guests of the Woodmont Club.

IT IS not necessary for these privileged hunters to confine their attention to wild turkeys, however, for the preserve abounds in deer, quail, pheasant, and mallard ducks. Every year a 10,000-egg incubator hatches out 4,000 ducklings, 4,000 young pheasants, and 2,000 quail. A careful check is kept of the kill and, as a check on this, an annual game census is taken. In this way, the club learns just what replacements are necessary to keep the flocks at the maximum set by the food supply.

Pheasants and quail, after hatching, are kept in range houses and, during the hunting season, are driven over blinds by beaters. About forty percent of the birds are killed in this way, the others escaping to the preserve where they are later hunted over dogs.

The 800 Virginia and white-tailed Michigan deer on the preserve are bred not only to provide sport for club members but to distribute to other hunting preserves. Hunters kill from fifty to seventy-five animals yearly, making it necessary to dispose of a dozen or so more to keep the herd within limits.

Within the enclosure, however, the most popular sport has always been, and probably always will be, that of shooting wild turkeys. This is game that by its quick wit, its courage, and wariness gives the hunter the greatest sense of triumph when he is fortunate enough to bag one.

DON'T LOOK DOWN ON YOUR FEET

(Continued from page 39)

Toes were narrowed and lengthened. Civilized man had started on the painful job of making his feet fit his shoes.

That job is still being carried on, but not to the extent that it was a quarter of a century or so ago. More and more people are demanding, and getting, comfortable and well-fitted shoes. For that improvement we should thank an army surgeon, Brigadier General Edward L. Munson. The famous "Munson last" shoe that he designed for our army gave regulars and National Guardsmen a taste for real foot comfort which they carried back into civilian life. The civilian shoes of today are more graceful than the army shoes, but there is scarcely a man's street shoe made in America that does not show the influence of General Munson's ideas.

EVEN women's shoes have been influenced by the trend toward more comfortable footwear, although most women still disregard the advice and warnings of physicians and foot specialists and continue to wear high heels. And many of the ladies, regarding tiny feet as desirable, insist on disregarding plain facts and wearing shoes that aren't large enough for their feet. In that respect they are less sensible than the Chinese women who, after centuries of binding the feet of baby girls to keep them small, took advantage of the Chinese revolution to demand and achieve foot freedom.

How can foot troubles be averted, and how can they be cured?

For information on those questions I called on Dr. Louis Schwartz, a surgeon of the United States Public Health Service, who has made a study of vocational foot troubles, and who is an authority on the hygiene of the feet.

"Our feet," Dr. Schwartz told me, "often are called on, because of our occupation or of our mode of dress, to do their work under unfavorable conditions. This results in the weakening and impairment of them, and unless we take special care of these often overworked parts, they will break down.

"The best preventive for corns and calluses, bunions and ingrowing toenails, overlapping toes, and other foot deformities that are painful and that lessen our efficiency, is a simple one: Just wear shoes and stockings that are long enough and broad enough not to cramp your feet.

"Shoes should be broad and roomy at the toes. The inner borders of the sole and heel should be in a straight line. The sole should be moderately thick, thick enough for adequate protection, but not so thick and rigid that it will hamper the normal motion of the foot in walking. It should follow the natural shape of your foot, and should project a little beyond the outline of the toes. It should be perfectly flat from end to end, and from side to side.

"HEELS should be broad and low, and the shank should be narrow and flexible. Care should be taken to see that the shoes fit well around the instep. The tops should be made of soft leather.

"Both the length and breadth of the foot increase about half an inch when the weight of the body is thrown on it. For that reason always be sure, when buying shoes, that they are large enough to be comfortable when you are standing with all your weight on one foot. Take plenty of time when you buy a new pair of shoes, and insist that the salesman fit you properly.

"Be sure that your stockings are longer than your feet. Stockings that are too short are the cause of bunions and many other foot troubles.

"Many women *(Continued on page 111)*

DON'T LOOK DOWN ON YOUR FEET

(Continued from page 110)

who have become accustomed to wearing high-heeled shoes say that they find low heels painful. Of course, they do. Constant wearing of high heels shortens the muscles on the back of the calf of the leg. To go from high heels to low heels demands the stretching of these muscles, a process that is naturally painful. The best way is to decrease the height of the heel by degrees. Occasional wearing of high-heeled shoes on dress occasions isn't especially harmful, but they should never be worn when there is much walking, or prolonged standing, to be done. Nature intended us to stand and walk in such a position that the heels are on the same level as the toes. High heels tend to make us fall forward, to disturb the relation of our internal organs, and to deform the arches.

"TO PRESERVE our arches, it is very necessary that we walk naturally. The natural, and therefore the correct, way is to walk with the feet pointing straight forward, and parallel with each other. Young children should be taught to walk in this manner.

"The outer part of the longitudinal arch is the outer border of the foot. It is more solidly braced, and therefore better suited for weight carrying, than is the higher and more elastic inner side of the arch. If the feet are pointed straight ahead in walking, the weight comes on the outer edge of the longitudinal arch, where it belongs. If the toes are turned out, the weight is thrown on the inner side of the arch, and tends to break it down.

"Sometimes weak feet can be made strong by exercises. Here are a couple that are good:

"Rise as high as possible on the toes. Turn the heels outward and the inner sides of the foot inward. Come down slowly. Repeat twenty or thirty times.

"STAND on the outer borders of your feet, with your toes turned in. Rise as high as possible on the toes, and slowly sink down, turning the feet so that the weight rests on their outer borders.

"Riding a bicycle is a good method of strengthening weak feet. When sitting down, it is a good habit to cross the feet, not the legs. This brings the feet to rest on their outer borders, and puts the entire body in a relaxed, restful position.

"During the past few years we all have heard a good deal about the ailment commonly called 'athletes' foot.' We have heard so much about it that some people have come to regard it as something of a joke. But it isn't any joke. It is painful, bothersome, and occasionally really dangerous.

"Athletes' foot is caused by the ringworm organism which thrives in dampness. Its most common symptom is cracking and scaling of the skin between the toes, but sometimes it shows up in a skin eruption on some other part of the body, caused by the system absorbing pus generated by ringworm fungus growing between the toes.

"To guard against athletes' foot, care should be taken always to wear slippers or sandals while using public or semi-public shower baths, swimming pools, or locker rooms. Household pets often carry the infection, so it is unwise ever to go barefoot where they are present. After a bath, the skin between the toes should be dried gently but so thoroughly that no moisture remains. Stockings should be changed frequently.

"The person who has contracted this ailment should, in common fairness to others, refrain from using public bathing facilities, and from going barefoot in locker rooms. Care, and the use of a good antiseptic foot powder, sometimes will work a cure, but it is better to consult a physician."

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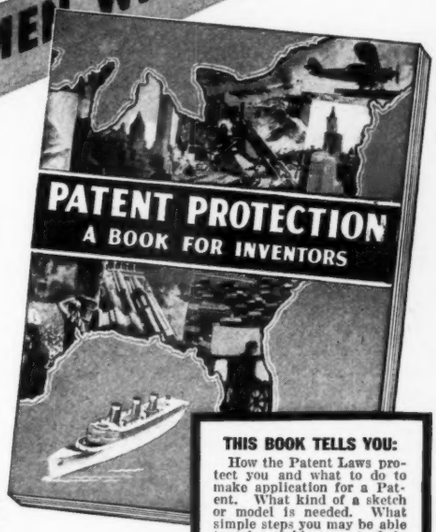

C. F. KETTERING

Vice Pres., General Motors Says This about Invention

In statement in Good Housekeeping Magazine, Charles F. Kettering, who helped develop the self-starter, Duco, and other important inventions, said: "Our return to normal times depends on new manufactured products that will catch the purchaser's eye, get him to buy and start the ball rolling. Change and buying go together. *We're only entering the great period of inventive advancement.*

SOME of the world's best inventions came from men who didn't consider themselves inventors at all. The telegraph was invented by a painter, the typewriter by a farmer; a bank clerk figured out the hand camera, a dentist the stock ticker. Or look at small inventions: A husband noticed his wife bending a hair pin to make it stay put. That gave him the idea of the crinkly hair pin. One day a golfer got the idea to make a wooden tee. Now wooden tees are sold by the millions every year. There are many similar examples in inventive history. That is why we say that the book shown here is for INVENTORS and Other Men with IDEAS. Whether you consider yourself an inventor or not—if you have an invention that will make money, save time, save labor, or give pleasure—you should find out how you can protect your rights to it. And this interesting, FREE book, PATENT PROTECTION, will tell you.

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Collecting Butterflies Thrilling Home Hobby

(Continued from page 52)

young collector who has captured tens of thousands of butterflies and moths around Los Angeles has developed a simply made trap requiring no special care. Cut the bottom from a large funnel, leaving a two-inch projection. Cut a one and one half inch hole through the top of a one-quart mason jar, insert the funnel stub, and solder tight. Fasten the funnel to a metal roof by wires or strong cord, attach an electric light bulb underneath the roof, and place cyanide in the jar.

SET the trap out at night and take out your catch the next morning. Set it on high ground, so the light can be seen from a distance at the edge of an open spot in the woods, a meadow, creek, or river bottom. Try it in different locations and you will be surprised how easy it is to catch moths.

Here is another trap easy to construct. Make a box ten inches wide, fifteen inches high and twenty inches long, leaving one side of the box hinged at the top and one end of the box open. Inside the box near the closed end place a small coal-oil lamp or an acetylene lamp. A round hole is cut in the top of the box to allow the heat of the lamp to escape and over this hole is a cover made from a tin can. Place a piece of bright tin back of the lamp for a reflector. In front of the lamp install a glass partition and immediately in front of this partition cut a hole in the bottom of the box in which is fitted the open mouth of a killing jar. The top of the killing jar should be level with the floor. In front of this an opening is made by two panes of glass. The opening between these two pieces of glass should be about three fourths of an inch wide. The moth enters through this opening and in trying to get to the light falls into the cyanide jar which should contain sufficient cyanide and moisture to act quickly. On dark nights a great many moths can be caught this way.

BUTTERFLIES and moths destined for the owner's own collection may be expanded for mounting as soon as they have been killed, and doing this properly spells the difference between a slovenly collection and a handsome, well-kept one. To expand a specimen, place it back down on a soft board and pin it through the body, from the underside, onto the board. Place a pin on each side of the body far enough back to keep the body straight. Draw the forewings forward until the rear edges are at right angles to the body, forming a straight line across the body; then pin strips of paper over them to hold them in that position. Next bring each lower wing up to the edge of the forewing and pin strips of paper over it to hold it in that position. Transparent paper is best and some collectors use architects' tracing cloth. These strips of paper may be cut in convenient size and used many times. Sometimes strips of glass are laid on to hold the wings in position, but one usually has better success with the paper strips. A pin is generally used to move the wing into position, catching it back of the upper rib of the wing, being careful not to make a hole through the wing. Do not pin through the wing but pin the strips of paper just outside the edge of the wing. The antennae should be held in position by placing pins on each side. The most important point in spreading butterflies is to bring the forewings forward until their lower margin forms a straight line across the body. After the specimen is properly expanded and pinned onto the board, hold the body down and remove the pin that fastened it to the board while it was being spread. Leave specimens pinned to the board until they are thoroughly dry, a week, if spread when first killed.

Both butterflies and moths properly displayed on cotton under glass are very attractive and retain their beauty for a lifetime. You can make your own mounts at very little expense. Get empty cardboard boxes approximately an inch deep, such as handkerchief or glove boxes. Fill with sheets of cotton batting cut to shape. On top of this cotton place a thin layer of pure white hospital absorbent cotton.

Now take the top of the box, and with an even strip of wood for a ruler, cut out the center with a sharp knife or safety razor, leaving a margin one half inch wide of the top remaining. Next take a piece of window glass so cut that it will fit snugly inside the box against the top and glue it in place. The material generally used to cover these mounts is black pebbled paper that looks like leather and is inexpensive. When the mount is completed place your butterflies on the cotton and put on the cover of the box, which is now a glass top through which you can see the specimens. Sprinkle some powdered moth balls or naphthalene flakes in the bottom of the box or between the sheets of cotton. This will save them from the pests.

YOU can get several different sizes of boxes from the usual drygoods store or you can use sheets of cardboard and make up any sized mount that you want. You can use pressed flowers, grasses, etc., in connection with the butterflies and many of you who live in the country can obtain the silklike floss from the pods of the milkweed in late summer or fall that will come in nicely in mounting your specimens.

When you cannot mount a freshly-killed specimen immediately, or if it is intended for exchange or sale, it should be placed unmounted with wings folded back to back in a triangular paper envelope. These envelopes are easily made.

Cut your paper to the following sizes: three and one half inches by five and three fourths inches for small butterflies, four and one fourth inches by seven inches for medium sized butterflies, and five inches by eight and one-fourth inches for large butterflies.

Referring to the diagram accompanying this article, first fold number 1, next number 2-2. Use any medium soft paper like newspapers but do not use heavy glazed paper. If you select plain paper, however, it is easier to write any memoranda on it. This is the way that your envelopes must be made if you expect to take proper care of your specimens. Do not use thin tissue paper.

THOUSANDS of specimens are made unexchangeable each year by the failure of collectors to take proper care in putting them into the triangular envelopes. It is not enough simply to put their wings in resting position and put them in the envelopes any old way. Put them in as instructed, with the antennae facing along the fold. Specimens thus stored may be kept safely for many years, or can be sent by mail anywhere. At any time desired, they may be softened and expanded for mounting in the following manner:

Place some blotting paper, moistened with water in which you have put a few drops of carbolic acid, in the bottom of a tin box or any vessel with a tight-fitting cover. Put the butterflies in this box, and cover and leave them until they become as soft and pliable as when first killed.

Butterflies may be removed from the triangular envelopes before placing them in the softening box or they may be left in the envelope, which usually takes longer to soften them properly but involves less danger of breaking them or making them wet or soggy. If taken out of the envelopes first, paper should be placed over them in the softening box to prevent drops of water condensing and falling on the specimens. With a little practice you will have no trouble in softening them.

When sufficiently softened, remove the butterfly from the box and mount it as previously described, except that only two or three days will be needed for drying.

Throughout the world collectors are eager to exchange rare and beautiful butterflies for others not found in their particular country. Some of my most prized specimens have come to me from amateur collectors in far-distant places. For that reason, it is important to pack your specimens properly for shipment. Small lots may be sent by mail to almost any part of the world in cigar boxes or other light but strong wooden boxes. If cigar boxes are used they should be enclosed in corrugated cardboard and then securely wrapped in strong paper and they should be tied securely with strong twine.

By such exchanges you can round out what may easily become a fine, representative collection of butterflies, not only of your own locality but also specimens from all parts of the whole world.

Leaping Auto That Can't Turnover

DAVID G. HALL, of San Diego, Calif., claims to have built a car that will not turn over even when subjected to treatment that would wreck an ordinary machine. Photograph shows his auto leaping into the air as it strikes a bump but nevertheless remaining upright.